The Town of Mariposa with Stockton Creek Reservoir in right background

State of California

THE RESOURCES AGENCY

Department of Water Resources

BULLETIN No. 131

MARIPOSA AREA INVESTIGATION

Preliminary Edition

NOVEMBER 1965

HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

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PARTMENT OF WATER RESOURCES
BOX 388
AMENTO

WILLIAM E. WARNE, Director

September 8, 1965

Honorable Edmund G. Brown, Governor,
and Members of the Legislature
of the State of California

Gentlemen:

The preliminary edition of Bulletin No. 131, entitled "Mariposa Area Investigation", culminates an investigation conducted under the continuing California Water Development program of the Department of Water Resources.

The main objective of the Mariposa Area Investigation was to develop information which would provide assistance in alleviating water problems of the area. This report contains information on available water resources, present and future water requirements, and proposed methods for water development. Four proposed local water development projects are described which would provide supplemental water supplies for the communities of Greeley Hill, Coulterville, Bear Valley, Hornitos, Catheys Valley, and the town of Mariposa. A proposed method for the development of the South Fork of the Merced River is also presented.

All public and private agencies, local interests, and individuals who may be concerned with the information presented herein are invited to submit their comments.

Sincerely yours,

William E. Warne

Director

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor, State of California
HUGO FISHER, Administrator, The Resources Agency
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Mariposa, California

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CHAPTER I. INTRODUCTION

Water resources originating in the mountain and foothill regions of Mariposa County are needed for the development of lands in the Mariposa area and the San Joaquin Valley. If maximum development is to be achieved, it is essential that those concerned provide future water service to both upstream and downstream regions. The economy of lands on the valley floor can provide financing of water conservation projects at the present time, but the economy of the foothill areas would not justify conservation projects for a long time in the future. This report presents a plan which would allow maximum utilization of the total water resources on the valley floor, and also provide supplemental water service to upstream areas. A diversion from the South Fork Merced River into upstream areas of Mariposa County was found to be essential to the ultimate development of these areas, and the plan of development as presented contains this feature.

The Mariposa area has a water supply condition which is common throughout the southern foothill region of the Sierra Nevada. Water resources are generally deficient, storage is difficult, and the costs of conservation are high. This study provides needed data upon which a plan could be formulated. Similar water resource studies are presently being extended into Madera County and contiguous areas, and include a further study of the Chowchilla River Drainage Basin. The area of this investigation is shown on Plate 1, "Location of Mariposa Area".

Objective of Investigation

The objective of the Mariposa Area Investigation was to develop information which would provide assistance in alleviating water problems

of the area and to establish continuing data gathering programs necessary for more detailed studies of water resources. The information consists of basic data concerning the extent of available water resources, engineering analyses of means of conserving the water resources, and evaluations of accomplishments which would be obtained from supplemental water supplies.

Studies were made to determine which potential conservation projects were most capable of near future development, and to present information in regard to their probable costs and accomplishments. Proposed projects included provide information which could be used by local agencies in planning water development for the area.

Scope of Investigation

The scope of the Mariposa Area Investigation included studies of water supply and the means of conservation and utilization of water within Mariposa County. The area of investigation includes the drainage system of the Merced River, and those portions of the drainage systems of the Eastern Merced County Stream Group and the Chowchilla River that lie within Mariposa County.

Studies of the water resources included a detailed evaluation of the climatic conditions of the Mariposa area. This phase of the investigation encompassed an analysis of information gathered by other agencies, by local residents of the Mariposa area, and by the Department. The phenomena which have been studied include rainfall, snowfall, temperature, evaporation, and wind. A collection of historical records of precipitation and temperature data made on a daily basis for numerous recording stations is available in departmental files.

Because of the inadequacy of existing hydrological data in the Mariposa area, water stage recorders were installed on several small streams

within the area. Existing records of runoff were compiled and analyzed. These daily flow records are on file with the Department. Historical runoff was estimated at many sites that are under consideration as potential locations of water projects.

Studies of present and probable future utilization of water were included in the scope of the investigation. The studies of water utilization included a classification of the lands of the area regarding their adaptability for agricultural development, and the water requirements which would be associated with the development. The areas of various classes of lands were delineated on maps, and projections were made of crops which could be grown on them.

The investigation included studies of both the engineering problems related to water conservation and the costs which would be incurred in project construction. The engineering studies included geological investigations which were limited to surface inspections in regard to foundation conditions. Exploration for construction materials included the boring of holes to evaluate the availability of suitable construction materials. A limited amount of information in regard to geological investigations was incorporated into this report, and additional information in this regard may be obtained from the Department.

Related Publications

Water resource investigations of the Mariposa area have been made by the Department of Water Resources, by its predecessor agencies, and by agencies of the federal government, notably the Sacramento District of the U.S. Army Corps of Engineers. The U.S. Soil Conservation Service has made noteworthy contributions to Mariposa County in the planning and attainment of flood control and water and soil conservation developments.

Valuable information and data were obtained from reports and other publications issued by those agencies and by others. A complete list of the reports and publications which were utilized in this study is included below:

"Annual Reports of Merced County Agricultural Commissioner", 1952-56.

Bonner, Frank E., "Report to the Federal Power Commission on the Water Powers of California", published 1928.

Bowen, O. E. and Gray, Clifton H., "Mines and Mineral Deposits of Mariposa County, California", California Journal of Mines and Geology, Vol. 53, Nos. 1 and 2, pp. 35-343, January-April 1957.

California Department of Agriculture, "California Crop and Livestock Reporting Service Reports", Annual Reports, 1952, etc.

California Department of Fish and Game, "Fish and Wildlife in Relation to the Proposed Agua Fria Project", August 1964.

California Department of Parks and Recreation, "Recreation Study, Agua Fria Reservoir-Mariposa County", January 1964.

California Department of Public Works, Division of Water Resources, "San Joaquin River Basin", Bulletin No. 29, published 1931.

California Department of Public Works, Division of Water Resources, "Survey of Mountainous Areas", Bulletin No. 56, published December 1955.

California Department of Water Resources, "Agua Fria Investigation: Feasibility Study", Bulletin No. 145, August 1964.

----, "The California Water Plan", Bulletin No. 3, published 1957.

----, "Dams Within the Jurisdiction of the State of California", Bulletin No. 17, published 1960.

----, "Lower San Joaquin Valley Water Quality Investigation", Bulletin No. 89, published 1960.

California Department of Water Resources, Division of Resources Planning, "Climatology of the Mariposa Area", Office Report, July 1960.

California Department of Water Resources, San Joaquin Valley Branch, "Engineering Geology of the Agua Fria Damsite on Mariposa Creek, Mariposa County", Office Report, January 1964.

California Division of Mines, "Geologic Guidebook Along Highway 49--Sierran Gold Belt", Bulletin No. 141, September 1948.

California State Water Resources Board, "Water Utilization and Requirements of California", Bulletin No. 2, published 1955.

Cloos, Ernest, "Structure Survey of Granodiorite South Mariposa, California", American Journal of Science, 5th series, Vol. 23, pp. 289-304, 1932.

Davis, F. F., and Carlson, D. W., "Mines and Mineral Resources of Merced County, California", California Journal of Mines and Geology, Vol. 48, No. 3, pp. 207-254, July 1952.

McSwain, Kenneth R., Chief Engineer and Manager, Merced Irrigation District, Merced, California, "The Eastern Merced County Water Plan", September 1957, unpublished.

Merced Irrigation District, "Financial Statement and Annual Report", 1957, 1958, 1959, 1960.

Nelson, DeWitt, Chairman, California Public Outdoor Recreation Plan Committee, "California Public Outdoor Recreation Plan", Part I, 1960.

Secretary of State, "Economic Survey of Mariposa County", taken from "California Blue Book", State of California, Annual Report, 1958, etc.

Seismological Society of America Bulletin, "Seismic Regionalization", Vol. 49, No. 2, April 1959.

Taliaferra, N. L., "Manganese Deposits of the Sierra Nevada, Their Genesis and Metamorphism", Manganese in California, Bulletin 125, California Division of Mines, December 1943.

Turner, H. W., and Ransome, F. L., "Sonora Folio, California", Folio 41, Geologic Atlas of United States, U.S. Geological Survey, 1897.

U.S. Army Engineer District, Corps of Engineers, Sacramento, California, "Master Manual for Reservoir Regulation, San Joaquin River Basin, California. Appendix III, Reservoir Regulation Manual for Merced County Stream Group Project, California", 1954.

----, "Review Report for Flood Control on Chowchilla River Basin, California", July 1960.

U.S. Department of Interior, National Park Service, "Yosemite National Park Travel Survey", 1954.

University of California Agricultural Extension Service, "Agricultural Inventory for Mariposa County", Annual Report, 1957, etc.

Previous Investigations Conducted by the State of California

The California Legislature in 1947 authorized a comprehensive investigation of the water resources throughout the State of California.

(Calif. Stats. 1945, Ch. 1514, P. 2830; as amended by Calif. Stats. 1947, Ch. 908; Water Code Sec. 12616.) Funds were appropriated annually by the Legislature over a ten-year period for the completion of this important program of study.

As part of this program the accomplishments of an initial water resource investigation of the central Sierra Nevada were presented in Bulletin No. 56, "Survey of Mountainous Areas", Division of Water Resources, Department of Public Works, in December 1955. On June 12, 1956, the State Department of Finance filed Applications No. 17124 through No. 17131 in support of future possible water supply projects within Mariposa County contained in Bulletin No. 56.

In 1957 the Department of Water Resources published Bulletin No. 3, entitled "The California Water Plan", which presented the results of the statewide water resources investigations which had been in progress for 10 years. These investigations entailed a three-fold program of study: (1) to evaluate the water resources of California, (2) to determine present and probable ultimate water requirements, and (3) to formulate plans for the orderly development of the State's water resources to meet its ultimate water requirements.

The objective in the formulation of the California Water Plan was to provide a logical engineering basis for future administration of the water resources of the State, and for coordination of the efforts of all entities engaged in the construction and operation of water development projects to the end that maximum benefit to all areas and peoples of the State may ultimately be achieved. The California Water Plan gives consideration to water conservation and reclamation; to flood control and flood protection; to the use of water for agricultural,

domestic, municipal, and industrial purposes; to hydroelectric power development; to salinity control and protection of the quality of fresh waters; to navigation; to drainage; and to the interests of fish, wildlife, and recreation.

With respect to development within the Mariposa area, Bulletin No. 3 proposes the following described works:

> "Works contemplated to provide water for irrigable lands in the Merced River Basin lying north of the Merced River, as well as to enhance fish, wildlife, and recreation in this area, would include Coulterville, Butterfly, and Hayward Reservoirs. Lands in the basin lying south of the river could receive water diverted from the South Fork of the Merced River near Wawona and outside Yosemite National Park, and regulated in reservoirs on tributaries of the West Fork of the Chowchilla River, and on Mariposa and Bear Creeks. These reservoirs would enhance fish, wildlife, and recreation, and also would furnish water to certain lands in the Chowchilla River Basin.
>
> "Coulterville Reservoir, in addition to conserving the runoff of its own watershed, would regulate water imported into the area from Harden Flat Reservoir on the South Fork of the Tuolumne River, as previously mentioned. The water would be released from Coulterville Reservoir to Butterfly and Hayward Reservoirs for further regulation, and to serve irrigable lands and enhance fish, wildlife, and recreation. Water diverted from the South Fork of the Merced River at the Wawona diversion could be conveyed westerly in a tunnel into the upper watershed of the Chowchilla River Basin. As the water would be conveyed across the upper Chowchilla River watershed, some releases would be made for local application and to regulatory storage reservoirs in this basin, as is subsequently described. However, the major portion of the water would be conveyed out of the watershed and discharged into Agua Fria and Upper Bear Creek Reservoirs, located on Mariposa Creek and Bear Creek, respectively, and served to lands in the vicinity of the two reservoirs.
>
> "In addition to the foregoing works which would serve water to upper watershed lands and enhance fish, wildlife, and recreation, a major reservoir, Virginia Point, with a storage capacity of about 1,000,000 acre-feet, would be constructed on the main stem of the Merced River immediately above the existing McClure Reservoir. Releases from Virginia Point Reservoir would be made through a new power plant into McClure Reservoir. From McClure Reservoir, the water would be discharged through an enlarged Exchequer Power Plant, the Merced Falls Power Plant, and then diverted for irrigation in the Merced Irrigation District

and adjacent areas in the San Joaquin Valley. Reservoir space in the amount of 180,000 acre-feet would be reserved in Virginia Point Reservoir to control floods on the Merced River. Releases would be made from the reservoirs to sustain flows for the preservation of fish life.

"As mentioned previously, a portion of the water diverted from the South Fork of the Merced River would be released in the Upper Chowchilla River Basin. This water, which would be released to four small reservoirs; namely, Darrah, Magoon, Pegleg, and Humbug, and to farm-size reservoirs, would meet substantially all water requirements in the upper portions of the Chowchilla River Basin which have no alternative source of supply. Lower lands in the basin would receive water from Buchanan Reservoir on the Chowchilla River, which would also furnish water to and provide flood protection for lands on the San Joaquin Valley floor".

The above described works are shown in Bulletin No. 3 on Sheet 11 of Plate 5, entitled "Plans for Water Development Under the California Water Plan".

Previous Investigations Conducted by the U. S. Army Corps of Engineers

The Sacramento District of the U. S. Army Corps of Engineers has conducted investigations on all three of the drainage basins covered under the Mariposa Area Investigation. The primary purpose of each of these investigations has been to plan for the accomplishment of flood control. In regard to the recommended method of development of the Merced River and the Chowchilla River, multiple-purpose reservoirs were recommended for the Virginia Point site on the Merced River and the Buchanan site on the Chowchilla River. No formal report was issued by the Corps of Engineers in reference to the studies on the Merced River; however, a considerable amount of information covering these studies is available in its Sacramento District Office.

The studies made by the Corps of Engineers on the Merced River Basin suggested that the multiple-purpose development of the river could be accomplished by the construction of a major dam and reservoir at the

Virginia Point site immediately downstream from White's Gulch. Information which was gathered by the Corps of Engineers in regard to the Merced River Basin has been used extensively under the Mariposa Area Investigation.

The results of work done under studies of the Chowchilla River by the Corps of Engineers were published in a draft for limited circulation in "Review Report for Flood Control on Chowchilla River Basin, California" in April 1960. Information in regard to the Buchanan project was contained in House Document No. 367, 81st Congress, 1st Session.

The work done by the Corps of Engineers under studies of the Eastern Merced County Stream Group led to the construction of flood control projects on Burns, Bear, Owens, and Mariposa Creeks. The studies by the Corps of Engineers of the Eastern Merced County Stream Group were done during the period from 1946 through 1950. Information resulting from those studies was published in 1954, as "Appendix III, Reservoir Regulation Manual for Merced County Stream Group Project, California, Master Manual for Reservoir Regulation, San Joaquin River Basin, California".

Three of the flood control dams constructed by the Corps on these streams, namely Mariposa Creek, Owens Creek, and Bear Creek, are located within Mariposa County at the edge of the foothills near the county line. The Burns Creek Dam is located within the boundary of Merced County. The general features of these dams and reservoirs are shown in Table 1, "Flood Control Dams, Eastern Merced County Stream Group".

TABLE 1

FLOOD CONTROL DAMS,
EASTERN MERCED COUNTY STREAM GROUP

Name of dam	Drainage area, in square miles	Storage capacity, in acre-feet	Height, in feet	Crest length: in feet	Year completed
Bear Creek	72	7,700	92	1,830	1950
Burns Creek	74	6,800	55	4,074	1950
Mariposa Creek	107	15,000	88	1,330	1948
Owens Creek	26	3,600	75	790	1949

Investigations Conducted by Soil Conservation Districts Within Mariposa County

The local residents of Mariposa County have been very active during recent years in the conservation of local water resources. Two Soil Conservation Districts have been formed in Mariposa County. The Coulterville-Greeley and the Mariposa Soil Conservation Districts have been formed under the provisions of the California Public Resources Code as provided for in Division IX. These districts cover 728,688 acres of land, 232,929 acres of which are classified by the districts as agricultural land.

These two districts were formed in the latter part of 1955 and early in 1956. They have adopted land improvement programs and have made plans for carrying them out. Among the many things included in the district programs are studies of conservation needs of the areas. Under this item an inventory is being made of the land and water needs within the districts.

The districts furnish technical assistance to individual farmers

or ranchers for the completion of water rights applications before the State Water Rights Board. Range and woodland improvement programs have been undertaken by the districts which include establishment of better range grasses and conservation of water supplies for development of irrigated pastures. Farm planning assistance has been provided, and an equipment program has been established to furnish farmers and ranchers with means to carry out conservation projects.

During the life of the two conservation districts in Mariposa County up until 1960 over 120 property owners were given assistance in the filing of water rights applications, and 155 reservoirs and farm ponds were constructed through the assistance of the districts. Many of these small reservoirs are used for irrigation purposes. The farm ponds serve the need for livestock water. Many of these reservoirs and ponds have been stocked with fish, and now provide recreation benefits to the local residents and their friends. Usually the livestock watering ponds are small (from 2 to 12 acre-feet in capacity) while the irrigation reservoirs have capacities up to 520 acre-feet at the McMahon Reservoir on Maxwell Creek. Most of the irrigations reservoirs, however, have capacities of from 10 to 50 acre-feet, and many are too small to be under the jurisdiction of the supervision of dams program of the State of California.

Outstanding assistance in the design of dams and the formulation of water conservation projects has been given to the local people by the soil scientists of the Soil Conservation Service, United States Department of Agriculture. These soil scientists have mapped the lands throughout the conservation districts for several years, and as of June 30, 1959, a total of 101,517 acres had been mapped and delineated on aerial photographs of the county for use by farmers and ranchers.

Area of Investigation

The Mariposa area lies along the western slope of the Sierra Nevada, extending from the Tuolumne-Merced River Divide on the north into the headwaters of the Chowchilla and Fresno Rivers on the south. The area includes the entire County of Mariposa and the portion of the Merced River drainage basin in Madera County. The western portion of Mariposa County encompasses the foothill drainage basins of the streams of the Eastern Merced County Stream Group, and the eastern one-fourth of Mariposa County lies within the boundaries of world-famous Yosemite National Park.

Climate

The Mariposa area, extending from the floor of the Central Valley to the crest of the Sierra Nevada, has a broad variety of climatic types. These types vary with the elevation throughout the study area and are characterized by hot summers; cool, mild winters; little rainfall during late spring, summer, and early fall; and comparatively heavy precipitation during a few winter months.

There are large differences in both temperature and precipitation within relatively short distances because of conditions of exposure and elevation. Average daily maximum temperatures at the lower elevations are above 90 degrees Fahrenheit during the months of June, July, August, and September; but there is an average drop of about 35 degrees each night. This makes the summers much more pleasant in the Mariposa area than on the valley floor. At the higher elevations above 4,500 feet, the summer daytime temperatures are generally within comfortable range, and evenings and nights are quite cool.

Temperatures during winter, spring, and fall are relatively mild in the vicinity of the town of Mariposa. At elevations below 1,500 feet the average daily minimum temperatures are above freezing even during January, the coldest month, although temperatures as low as 10 degrees Fahrenheit have been recorded. At the higher elevations in the Mariposa area, winter daily maximum temperatures are generally above freezing, but nighttime temperatures are usually well below freezing. Minimum temperatures below zero are not uncommon at elevations above 6,000 feet.

Data regarding the climate of the Mariposa area are presented in Table 2, "Climatological Data at Selected Stations in or Adjacent to the Mariposa Area".

Drainage Basins

There are three drainage areas included in the Mariposa Area Investigation: the Merced River Basin, drainage areas within Mariposa County tributary to the Chowchilla River, and the drainage areas of streams of the Eastern Merced County Stream Group which lie within Mariposa County.

The drainage area of the Merced River above Exchequer Dam consists of 1,035 square miles of mountainous and foothill lands, a large portion of which is within the heavy snow pack regions of the Sierra Nevada. The drainage basin includes about 158 square miles of area lying within Madera County. The Merced River watershed above Exchequer Dam ranges in elevation from 707 feet at the reservoir water surface to over 12,000 feet at the crest of the Sierra Nevada to the east.

TABLE 2

CLIMATOLOGICAL DATA AT SELECTED
STATIONS IN OR ADJACENT TO THE MARIPOSA AREA

Name of station	Elevation, in feet	Growing season, in days	Maximum and minimum temperatures for period of record, in degrees F: Maximum	Minimum	Mean annual precipitation, in inches
Huntington Lake	7,020	81	89	-18	31.31
South Entrance Yosemite Nat'l Park	5,120	125	102	- 3	44.10
Yosemite National Park	3,985	151	110	- 6	35.92
Dudleys	3,000	178	107	-10	38.05
Auberry	2,003	203	114	5	24.50
Cathay Bull Run Ranch	1,425	218	109	19	19.37
Le Grand	255	253	114	11	12.49
Merced Fire Station No. 2	168	259	116	16	11.92

The Mariposa County portion of the Chowchilla River watershed contains about 265 square miles of foothill terrain. The Chowchilla River watershed is almost entirely outside of the snow pack region, although it does extend to a few peaks which are over 5,000 feet in elevation.

The drainage area for the streams of the Eastern Merced County Stream Group within Mariposa County contains about 278 square miles of foothill lands. These lands are rugged and range in elevations from about 300 feet at the Merced County boundary to 4,200 feet on Bullion Mountain.

Geology

The Mariposa area is located on the gently dipping westward slope of the Sierra Nevada geomorphic province. Trending northwest along middle-eastern California, the Sierra Nevada province is approximately 430 miles long and ranges from 40 to 80 miles in width. It has been described as an immense, tilted fault block which ranges in elevation from near sea level along its western edge to a maximum altitude of 14,496 feet above sea level at Mount Whitney. This tilting of the Sierra block has forced a high, steep faultline scarp on the eastern face and rejuvenated the streams. Such rejuvenation has enabled the streams to cut deep canyons into the otherwise gentle western slope.

The Sierra Nevada in the Mariposa area is underlain by resistant, hard, and structurally competent metamorphic and intrusive igneous rocks that have undergone several periods of uplift and erosion. These rocks, often referred to as the bedrock series, include such types as schist, quartzite, slate, crystalline limestone, metavolcanic, granitic, and ultrabasic. Overlying the bedrock series are younger, essentially undeformed beds of sandstone, clay, and volcanic ash. Erosion has removed most of the rocks of this younger series. The remnants occur only along the western portion of Mariposa County. From Mormon Bar a northwest-trending fault system cuts through the foothills. Quartz veins and the Mother Lode mineral deposits are associated with this fault system. The geologic features described herein are delineated on Plate 10, Regional Geologic Map.

Final sculpturing by erosion was accomplished by streams cutting deeply into the bedrock and by several periods of glaciation in

the higher canyons, the latest of which occurred approximately 10,000 years ago.

The seismicity of the investigated Mariposa area is classed as low to moderate. Within the State, the Sierra Nevada is placed within one of the areas of lowest probable maximum intensity. The crystalline rocks which underlie this stable area are highly elastic, wherein the intensity of a seismic shock of a given magnitude is lower than in inelastic, less consolidated rocks. All the known faults in the area, including the Mother Lode fault system, are considered to be inactive. The nearest active faults are those that bound the eastern Sierran faultline escarpment near Mono Lake.

In addition to the notable gold resources mined in the Mother Lode area in Mariposa County, limited quantities of copper, lead, zinc, silver, and tungsten have also been found. The nonmetallic mineral resources in the area include barite, limestone, dolomite, mica, schist, slate, granite, silica, sand, and gravel.

CHAPTER II. WATER SUPPLY

(All tables related to water supply
are placed at the end of the chapter)

The Mariposa Area Investigation includes estimates of the available water supplies. These estimates were made for the three watersheds, or watershed groups, within the area; namely, "The Merced River Basin", "Drainage Areas Tributary to the Chowchilla River", and "Drainage Areas of Streams of the Eastern Merced County Stream Group".

The available water supply of the Mariposa area occurs primarily as runoff in the Merced and Chowchilla Rivers and a number of smaller streams. A secondary source of water supply is that which occurs in the form of soil moisture as a result of rainfall and snowfall. Some small wells and springs have been developed for domestic use, but there are no significant ground water basins in the Mariposa area. Estimated mean annual runoff presented in this report is based on streamflow records for the 35-year period from 1921-22 through 1955-56. The average runoff during this period reflects the long-term average runoff for the Merced River. References to annual runoff denote the runoff during the 12-month period from October 1 through September 30.

Information on general climatology is essential to an accurate appraisal of the water resources of an area. Data regarding temperatures, evaporation, and wind are particularly useful in evaluating use of water. Records were gathered concerning rainfall, snowfall, temperatures, evaporation, and wind. The estimates of average annual precipitation at many stations in the Mariposa area are presented in this report for the 50-year period from 1905-06 through 1954-55. References to annual precipitation denote the precipitation occurring during the 12-month period from July 1 through June 30.

Other aspects of water supply which were considered are the importation of water into or exportation of water from the area of investigation, and the mineral quality of ground and surface water.

The results of studies of water supply in the Mariposa area are presented under the following general headings: "Climatology", "Runoff", "Imported and Exported Water", and "Water Quality".

Climatology

Thirty-six climatological stations were established within Mariposa County during the investigation, and records from these stations were reported regularly to the Department. Twenty-four of these stations record only precipitation data; nine record precipitation and temperature data; and three record precipitation, temperature, evaporation, and air movement data. These records are of too short a duration for use in calculating long-term averages, but the Department will continue to maintain these stations, and in a few years sufficient climatological data will be available to permit more reliable studies.

Many local people in Mariposa County cooperated with the Department in the collection of climatological data for this investigation. The equipment for these climatological stations was supplied, installed, and periodically checked by the Department to assure the reliability of the records gathered by the local residents.

Precipitation

The frequency of occurrence of precipitation and the amount of precipitation are the result of several factors. Two basic factors which must be present, if precipitation is to occur, are an inflow of moist air and proper conditions to release the air's moisture. In

general, the moisture-laden air must be cooled in such a manner that the moisture will condense and form water or ice droplets large enough to fall. The type of storm in the Mariposa area is related to the origin of moist air. The rising slope of the Sierra Nevada contributes to the cooling of the air mass and the resulting pattern of precipitation.

During the summer months, influxes of heavily moisture-laden air into the Mariposa area are rare. The source of such air during this period is usually the Gulf of Mexico, or, occasionally, from tropical storms near the southern portion of Baja California. Influxes of these air masses are generally weak, and the resulting precipitation, if any, comes from scattered showers or thunderstorms. Summer convective-type storms are common at the higher elevations of the Sierra Nevada but are infrequent in lower areas.

During the winter months, storms moving into the North American Continent from the Pacific Ocean account for the major portion of the precipitation received by the Mariposa area. The air masses moving in with such storms have their source in the Pacific Ocean from either tropical or polar regions. Air masses originating in the tropical regions are relatively warm and, therefore, can contain large amounts of moisture. Storms dropping the heaviest amounts of precipitation, such as the December 1955 storms, are those consisting of tropical air masses. The precipitation from a polar storm is usually much less than that dropped by a tropical storm, since the cooler polar air has less capacity to carry moisture. Polar storms contribute a larger percentage of the precipitation in the Mariposa area, because of their greater frequency of occurrence.

Most precipitation in the Mariposa area occurs from storms sweeping in from the Pacific during the priod October 1 to April 30. On the average, approximately 93 percent of the total precipitation occurs during this time. The amount of precipitation increases with altitudes up to an elevation of about 7,500 feet. At the lower elevations the average annual precipitation is about 10 inches, and the amount of precipitation increases to over 50 inches at the 7,500-foot elevation.

Much of the precipitation in the Mariposa area falls as snow which forms a deep pack at the higher elevations. Accumulations up to 15 feet in depth have been measured. During an average winter, approximately 50 percent of the Merced River Basin above Exchequer Dam is covered with snow. On April 1, under normal conditions, about 750,000 acre-feet of water are stored in this pack. During the principal melt period of April through July, 60 to 70 percent of the water that was stored in this snow reservoir appears as stream runoff. The balance goes into the ground where it becomes a major source of moisture for the vegetation in the immediate area.

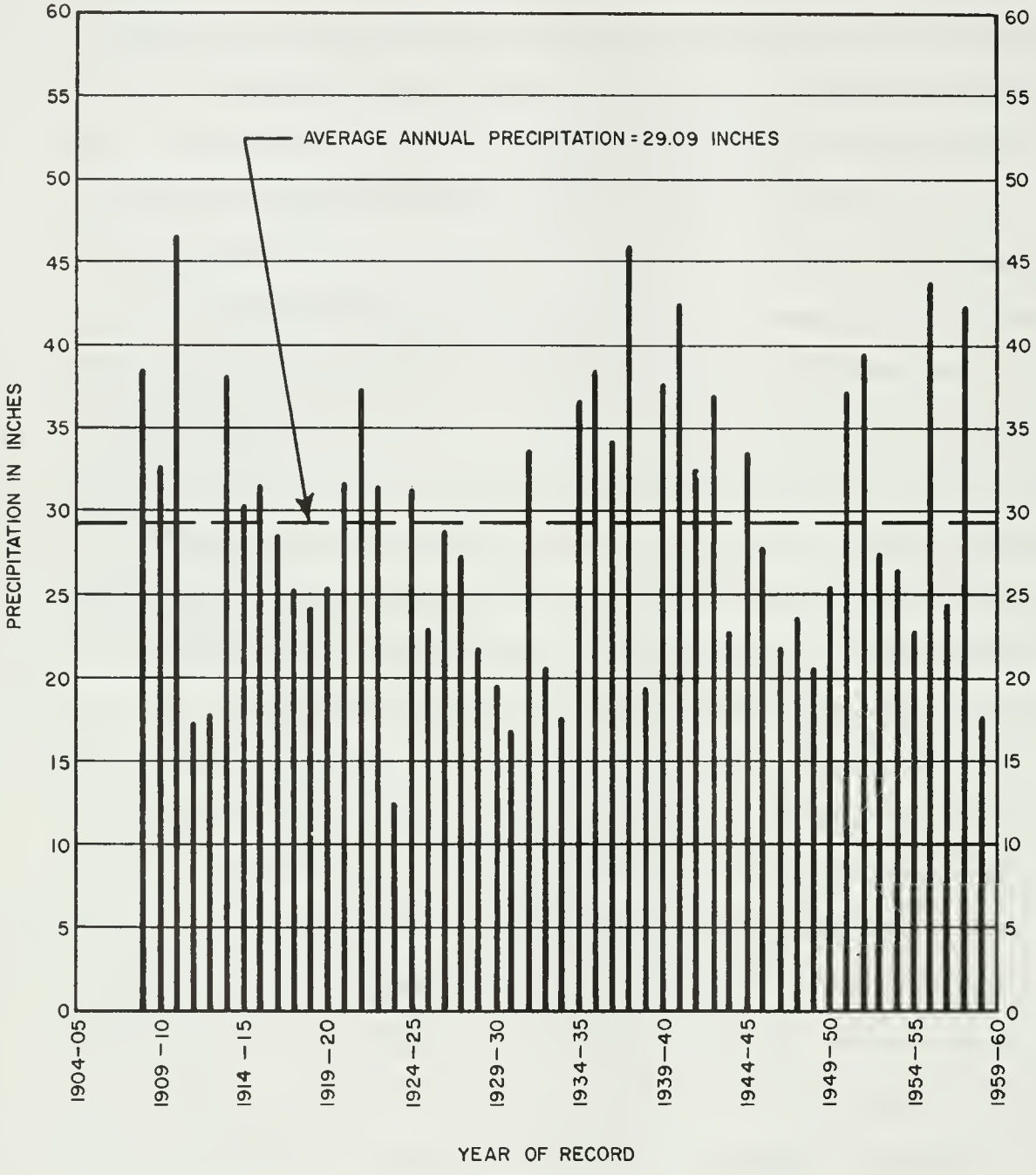
The first heavy snows of winter in the Mariposa area can be expected in late November or early December. Spring snowstorms are occasionally quite heavy as late as mid-May, and snow flurries have occurred in June and July. During the winter months, most precipitation above 5,000 feet falls in the form of snow. During warm-type storms, however, precipitation may be in the form of rain up to much higher elevations and may result in some melting of the snowpack. The storms of December 1937 and December 1955 were such warm-type storms, and it is estimated that rain fell at an elevation as high as 9,000 feet during their occurrences.

Snow conditions in the Mariposa area vary considerably according to time of year, time elapsed since last snowfall, and elevation. Hard crusts are characteristic of areas below the 8,000-foot elevation which are subject to alternate thawing and freezing. Above this level, a loose pack is more typical of conditions prior to the melt period.

The names and locations of precipitation stations in the Mariposa area, the period of record, the estimated average annual precipitation, and the maximum and minimum annual totals of record are shown in Table 3, "Recorded Maximum, Minimum and Estimated Mean Annual Precipitation at Stations in the Mariposa Area". Monthly precipitation records for certain stations in the Mariposa area are shown in Table 4, "Records of Monthly Precipitation Gathered Under the Mariposa Area Investigation". The pattern of occurrence of precipitation is illustrated by the isohyetal map shown as Plate 2, "Lines of Equal Average Precipitation". The locations of precipitation stations are also shown on Plate 2.

Mean monthly precipitation at selected stations in the Mariposa area, presented in Table 5, "Mean Monthly Precipitation in the Mariposa Area", shows that nearly all of the precipitation occurs during the winter period. At a typical lower elevation station in the Mariposa area (Le Grand), over 90 percent of the annual rainfall generally occurs in the six-month period from November 1 through April 30, and no significant amount of rainfall occurs during July and August.

Annual precipitation at Mariposa is illustrated in Figure 1, "Recorded Annual Precipitation at Mariposa". This presentation shows the occurrence of wet and dry periods. Figure 2, "Accumulated Departure from Mean Seasonal Precipitation at Mariposa", is a further analysis of periods



RECORDED ANNUAL PRECIPITATION AT MARIPOSA

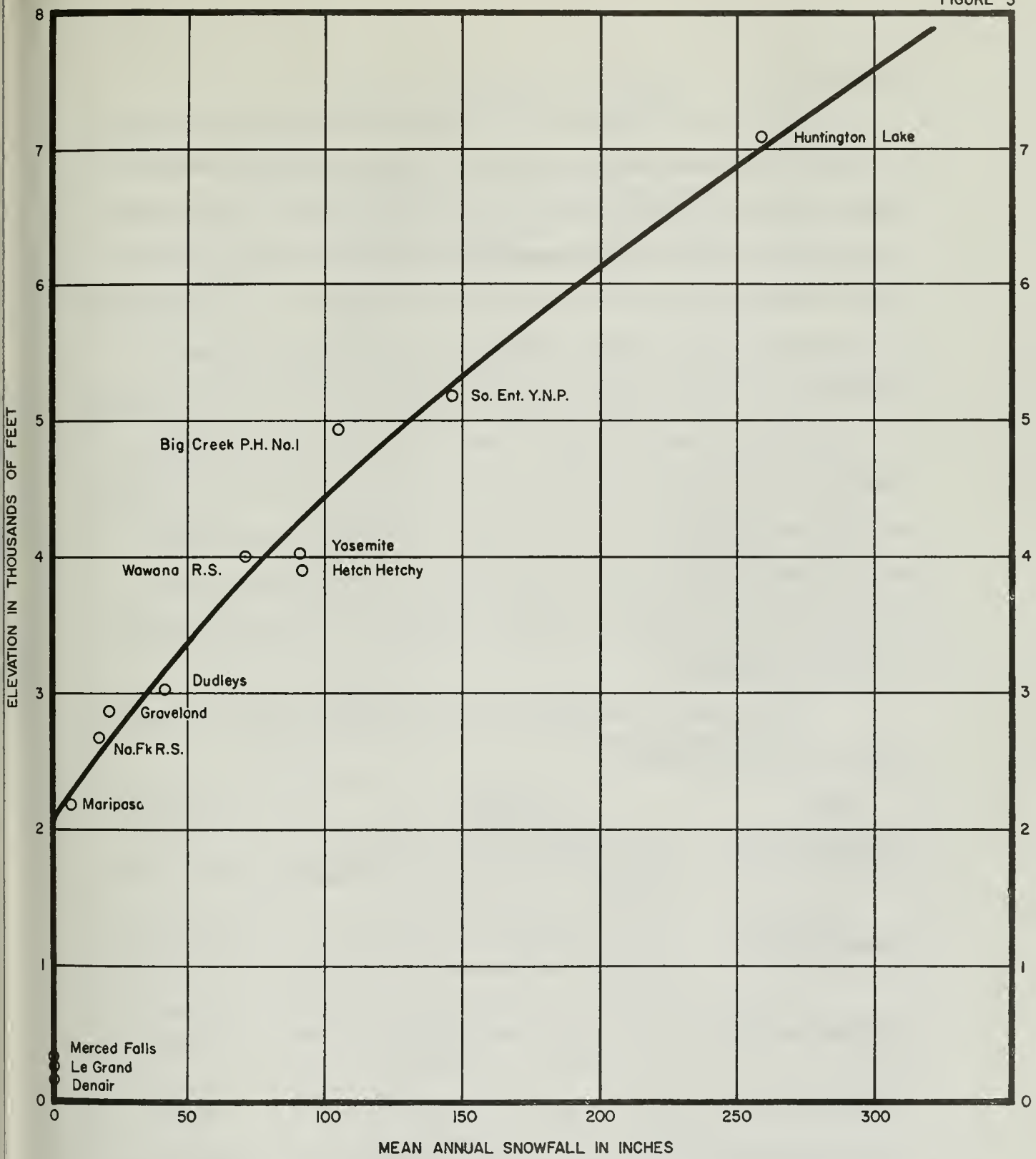
ACCUMULATED DEPARTURE FROM MEAN SEASONAL PRECIPITATION AT MARIPOSA

of wet and dry years and provides information for evaluating short-term records in relation to long-term trends. The 1905-06 through 1954-55 period is considered to represent long-term conditions.

The station within the Mariposa area which has the highest recorded average annual precipitation is located at Badger Pass, a distance of about eight miles southwest of Yosemite National Park Headquarters, at an elevation of 7,300 feet. There appears to be very little difference in the average annual precipitation in this region between the 7,000-foot elevation and the high peaks of the crest of the Sierra Nevada, which are over 10,000 feet in elevation.

Snowfall in the Mariposa area apparently varies uniformly with elevation. In this discussion, annual snowfall refers to the total annual amount of newly fallen snow, rather than the greatest depth which accumulates on the ground. The lowest elevation at which significant amounts of snowfall occur is about 2,000 feet, and there is an increase of about 50 inches of snowfall annually for each 1,000-foot increase in elevation up to the 7,000-foot elevation. The available records of average snowfall in the Mariposa area are tabulated in Table 6, "Average Annual Snowfall in the Mariposa Area", and the depths of snowfall are shown graphically in relation to elevation on Figure 3, "Relation Between Elevation and Snowfall in the Mariposa Area". The names of stations, estimated depths of snow, and estimated water content of snow are shown in Table 7, "Average Depth of Snow and Water Content in the Mariposa Area". In compiling these estimates, a considerable amount of data has been generalized, especially for the months of February, March, and May.

FIGURE 3



RELATION BETWEEN ELEVATION AND SNOWFALL IN THE MARIPOSA AREA

Temperature

There are 26 climatological stations within Mariposa County at which temperature data are recorded. Many of these stations are of recent activation. Summaries of records of 13 stations located within or near Mariposa County with temperature records of longer than five years' duration are listed in Table 8, "Annual Variation of Temperatures in the Mariposa Area". These values were taken from the "Climatic Summary of the United States--Supplement for 1931 through 1952 (Bulletin W)", published by the U.S. Weather Bureau. The highest and lowest temperatures of record for each month of the year are listed, as well as the average monthly and annual maximum and minimum temperatures. Monthly temperatures at the lower elevations of the Mariposa area range from a July average of about 80 degrees F. to a January average of about 45 degrees F.

Terms used in connection with the temperature data are defined in the following glossary:

Term	Definition	Abbreviation
Average maximum	The arithmetic average of daily maximum temperatures for indicated period	Avg. Max.
Average minimum	The arithmetic average of daily minimum temperatures for indicated period	Avg. Min.
Absolute maximum	The highest temperature of record at a station	Highest
Absolute minimum	The lowest temperature of record at a station	Lowest
Average temperature	The average of the maximum and minimum for each day; the daily averages are averaged to make the	Avg. temp.

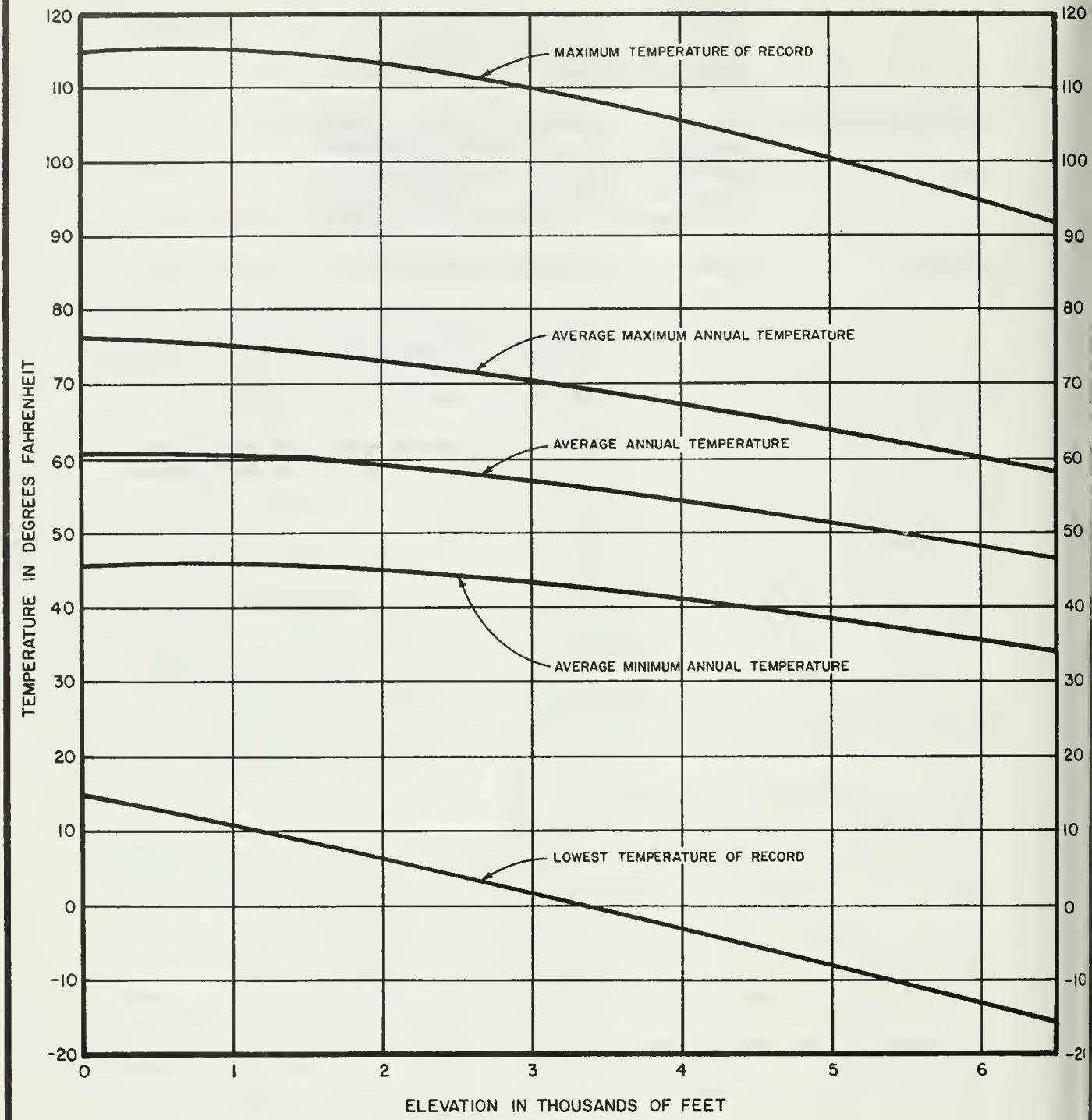
(Continued)

	monthly averages, and the monthly values are averaged to make the annual averages	
Freeze-free period	The period between the last spring minimum and the first fall minimum of temperatures between various freezing thresholds. (This is used for describing the growing season.)	
Degree	Refers to Fahrenheit scale in all cases	°F.

The average annual temperature decreases about 2.7 degrees for each thousand-foot rise in elevation in the Mariposa area. This is illustrated in Figure 4, "Temperature - Elevation Relationship in the Mariposa Area", which also shows the variation of the average maximum and minimum temperatures and the extreme high and low values. Some stations do not follow the general trend. These stations probably reflect local temperature climatology which, near the earth's surface, is influenced by the configuration and orientation of the terrain and by cultural developments. Poor instrumental exposure may also be responsible for part of the deviation.

The growing season may be defined as the period between damaging frosts on temperature-sensitive plants. Few data are available on frost damage; therefore, the "freeze-free" period is used in this summary to represent growing season. The freeze-free period, or the growing season, is defined as that average period between spring and fall during which no minimum freezing temperatures occur in the standard instrument shelter. This may or may not correspond to the actual growing season for any particular crop, since tolerance to cold varies for different crops, but it serves as an available index.

The freeze-free period at any point in the Mariposa area is



TEMPERATURE – ELEVATION RELATIONSHIP IN THE MARIPOSA AREA

affected principally by elevation but is modified by local conditions. There are about 240 consecutive days with no minimum temperatures of 32 degrees Fahrenheit or less at the 1,000-foot elevation, and for each additional 1,000 feet there are about 25 days fewer. Above an elevation of 8,000 feet, temperatures below freezing may be experienced in any month.

The temperature data on which the freeze-free period study was based are presented in Table 9, "Summary of Freeze-Free Period Data in the Mariposa Area".

Evaporation

Evaporation has been measured at eight locations in the general vicinity of the Mariposa area and is presently being measured at six of these locations. One of the evaporation stations, the floating pan on Don Pedro Reservoir, has been in operation since 1924, with only minor breaks in the record. There is a land pan nearby with a record since 1951. The only other active station with a long-term record is at Friant, where an evaporation record for a land pan has been maintained since 1940. These stations, together with pertinent annual data, are listed in Table 10, "Evaporation Records in the Mariposa Area". Four monthly evaporation records within the Mariposa area are shown in Table 11, "Records of Monthly Evaporation in the Mariposa Area".

Measured pan evaporation normally is greater than actual evaporation from the water surface of a lake or reservoir. To reduce the measured value to water surface evaporation, it is necessary to multiply it by a coefficient. The recommended coefficients applicable to the Mariposa area for converting average annual pan evaporation to

reservoir evaporation are 0.70 for Weather Bureau Class A pans and 0.90 for floating pans. These coefficients vary during the season according to the integrated effects of the meteorological factors on the various pans, and are highest in the late fall and lowest in the early spring.

Wind

The only station near the Mariposa area with a good record of wind conditions is Castle Air Force Base near Merced. A wind rose diagram for this station shows that almost 60 percent of the time the wind is from the north to west quadrant, and that the median wind velocity is about eight miles per hour.

Runoff

The watersheds encompassed by the Mariposa Area Investigation consist of the Merced River drainage basin, those of the small streams which flow westerly into Merced County and are generally referred to as the Eastern Merced County Stream Group, and those of the several tributaries of the Chowchilla River which originate within Mariposa County. The records of runoff of the Merced River are considered adequate and reliable for purposes of studies of water supply. There were no records of runoff available for the smaller watersheds lying outside of the Merced River Basin when this investigation was commenced.

Nine stream gaging stations were established in Mariposa County during the investigation. Four stations were established on the tributaries of the Chowchilla River (the East, Middle, and West Forks of the Chowchilla River and Striped Rock Creek), three stations were established on streams of the Eastern Merced County Stream Group (Mariposa, Bear, and Burns Creeks), and two stations were established on tributaries

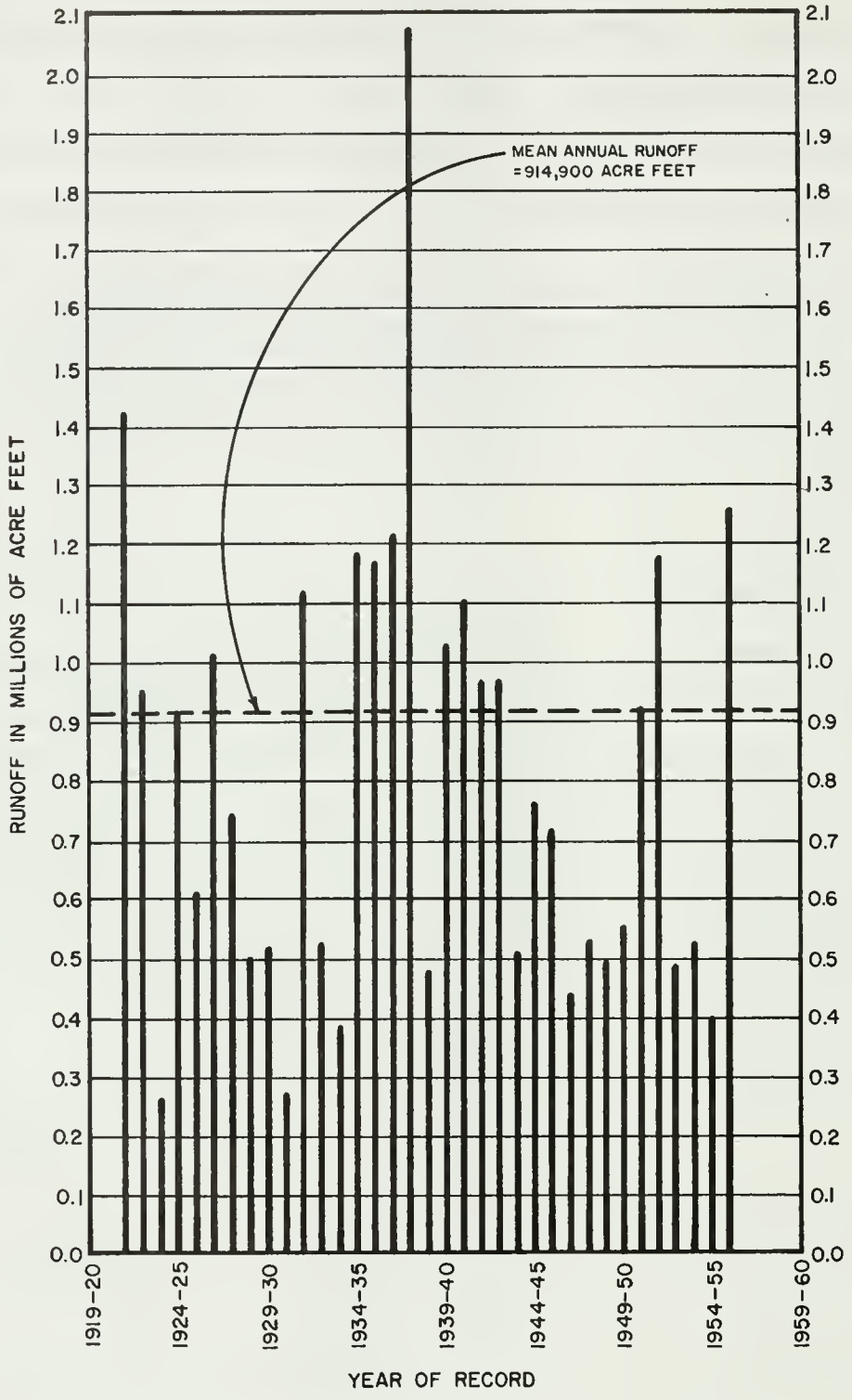
of the Merced River on the north side of the drainage basin in the general vicinities of Coulterville and Greeley Hill (Maxwell Creek and North Fork of the Merced River, respectively).

Stream gaging stations in and adjacent to the Mariposa area, together with their map reference numbers, the areas of the watersheds above these stations, and the periods and sources of record, are listed in Table 12, "Stream Gaging Stations in and Adjacent to the Mariposa Area". The locations of these stations are shown on Plate 2, "Lines of Equal Average Precipitation".

Runoff of the Merced River

The watershed of the Merced River contains the scenic wonders of Yosemite National Park, including snow-capped mountains and world-famous waterfalls. The runoff characteristics are those of a predominantly snow-melt region. The amount of runoff from the watershed varies between wide limits from year to year, and from month to month within the year. The estimated mean annual runoff of 915,000 acre-feet at Exchequer is based on the 1921-22 through 1955-56 period which has been selected as representative of long-term mean conditions. The maximum recorded annual runoff of the Merced River at Exchequer during this period was 2,077,700 acre-feet during the 1937-38 water year, and the minimum annual runoff was 252,300 acre-feet during 1923-24.

The recorded amounts of annual runoff of the Merced River at Exchequer for the period 1921-22 through 1955-56 are presented in Table 13, "Recorded Natural Runoff of the Merced River at Exchequer", and are also shown graphically in Figure 5, "Recorded Natural Runoff of Merced River at Exchequer". Because only minor amounts of consumptive



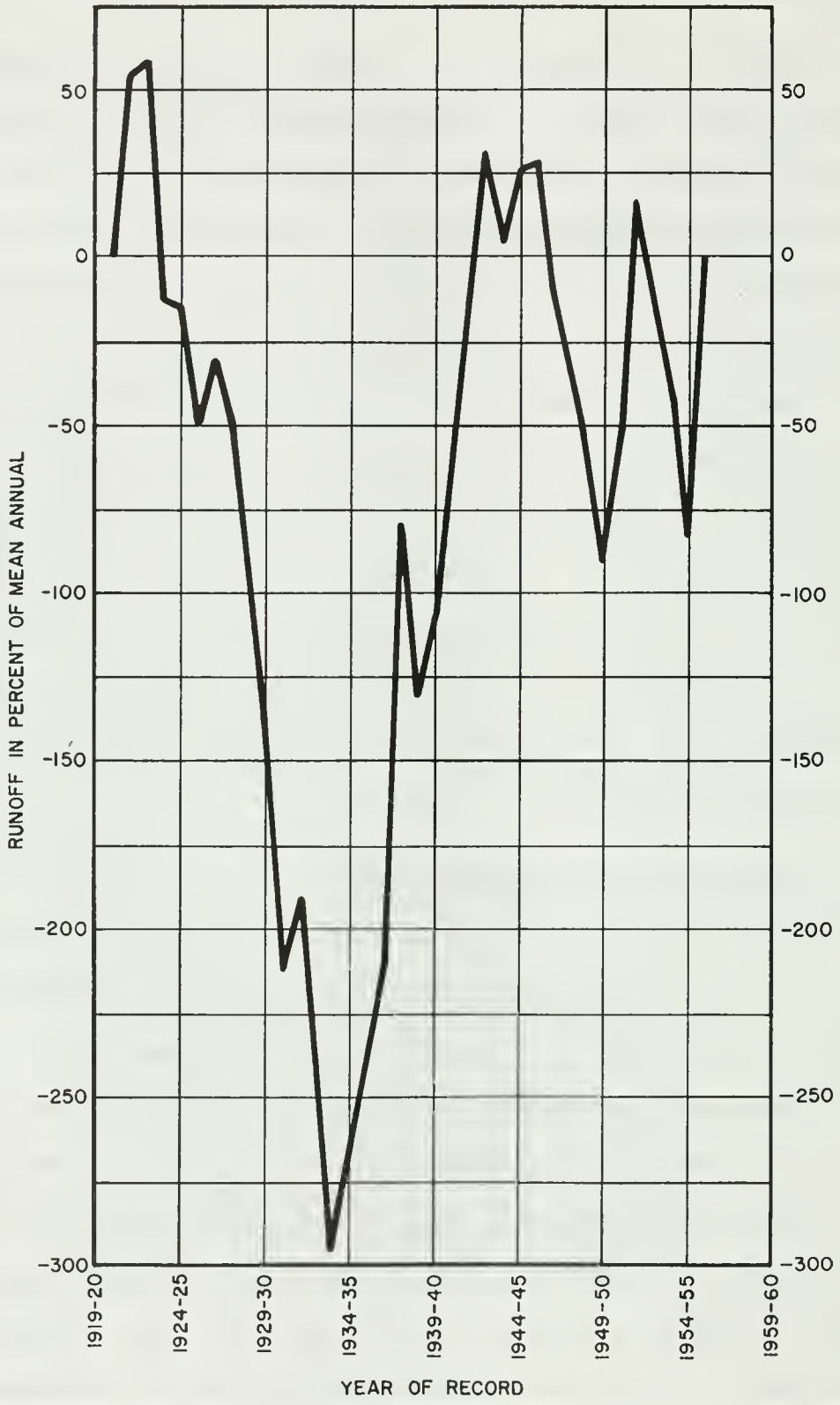
RECORDED NATURAL RUNOFF OF MERCED RIVER
AT EXCHEQUER

uses of water occur upstream from this point, the record is considered to represent natural flow. The estimated average monthly distribution of runoff is presented in Table 14, "Average Monthly Distribution of Runoff of the Merced River at Exchequer". The long-term trends of runoff of the Merced River are shown in Figure 6, "Accumulated Departure from Mean Annual Natural Runoff of Merced River at Exchequer".

Runoff of the Merced River at present is subject to only two small impairments. One of these is the water diverted for use in Yosemite National Park in Yosemite Valley, and the other is a minor irrigation diversion from Big Creek, a small tributary of the South Fork of the Merced River. The only significant amount of storage on the Merced River is in Lake McClure where storage for 289,000 acre-feet of water was developed by the construction of Exchequer Dam in 1926 by the Merced Irrigation District.

Runoff of the South Fork of the Merced River

The drainage basin of the South Fork of the Merced River near El Portal comprises 239 square miles of highly productive watershed. The South Fork of the Merced River is a predominantly snowmelt type of stream which yields about 70 percent of its average annual runoff during the three months of April, May, and June. Records of runoff are available for the gaging station near El Portal for the period from November 1950 to the present time. Some records are available for a gaging station near Wawona which was maintained during intermittent periods between 1910 and 1922. To estimate the mean annual runoff of the South Fork of the Merced River near El Portal, it was necessary to extend the existing records at this station to cover the period of 1921-22 through



ACCUMULATED DEPARTURE FROM MEAN ANNUAL
NATURAL RUNOFF OF MERCED RIVER AT EXCHEQUER

1955-56. The records of runoff were extended by correlating records for the South Fork of the Merced River with records of the South Fork of the Tuolumne River near Oakland Recreation Camp.

Estimates of runoff for several locations which have similar runoff characteristics on the South Fork of the Merced River were made for planning purposes. These estimates were made by distributing the runoff of tributary areas in proportion to the products of those areas and their respective mean annual precipitation. Estimates were made of the runoff of the South Fork of the Merced River below Bishop Creek to evaluate a proposed project, which is presented in Chapter IV, for development of the South Fork of the Merced River.

The estimated natural runoff of the South Fork of the Merced River below Bishop Creek is shown in Table 15, "Estimated Natural Runoff of the South Fork Merced River Below Bishop Creek", and the estimated average monthly distribution of runoff at this point is shown in Table 16, "Estimated Average Monthly Distribution of Runoff, South Fork Merced River Below Bishop Creek".

Runoff of Tributaries of the Upper Chowchilla River Within Mariposa County

The drainage areas within Mariposa County which contribute to the flow of the Chowchilla River have dissimilar hydrologic characteristics. The East Fork of the Chowchilla River originates in the relatively high elevations north of Miami Mountain; the drainage areas of the Middle and West Forks of the Chowchilla River include small areas of high elevation; and Striped Rock Creek and other small tributaries originate within the lower foothill areas of Mariposa County. The runoff from the higher

watersheds is influenced by snowmelt, and runoff from the lower watersheds occurs in much the same pattern as the rainfall.

There were no reliable records of runoff on the tributaries of the Chowchilla River in July 1957 when the Mariposa Area Investigation began. Stream gaging stations were established by the Department of Water Resources on the East and West Forks of the Chowchilla River and on Striped Rock Creek in the fall of 1957, and on the Middle Fork in the spring of 1958. The short period of record by these stations does not as yet constitute a reliable basis for estimating the mean annual runoff from these areas. Records of runoff gathered thus far at these gaging stations are shown on Table 17, "Records of Runoff on Tributaries of the Upper Chowchilla River".

Runoff of Streams of the Eastern Merced County Stream Group

The drainage basins of the streams of the Eastern Merced County Stream Group extend into the foothills of Mariposa County. The runoff from these small streams varies greatly between periods of light and heavy precipitation. The Corps of Engineers has made some streamflow measurements beginning in 1948 on Mariposa, Bear, Burns, and Owens Creeks, primarily for studies pertaining to flood control. When the Mariposa Area Investigation started in 1957, information on runoff of the streams of the Eastern Merced County Stream Group was insufficient for purposes of the investigation.

The Department established stream gaging stations on Mariposa Creek near Cathay and on Bear Creek near Cathay in the fall of 1957 and on Burns Creek at Hornitos in the fall of 1958. Runoff records at these gaging stations are shown in Table 18, "Records of Runoff on Streams of the Eastern Merced County Stream Group".

Runoff of the Tributaries on the North Side of the Merced River

There were no reliable records of flow of the North Fork of the Merced River at the beginning of this investigation. The Department therefore established in 1958 a stream gaging station on the North Fork of the Merced River at a bridge at Bower Cave and on Maxwell Creek at a point upstream from the town of Coulterville. Records of runoff for these sites are shown in Table 19, "Records of Runoff on the North Side of the Merced River Basin".

Imported and Exported Water

So far as was determined during the investigation there were no imports of water into the Mariposa Area. Export from the area is made by diversion of water from Big Creek, a tributary of the South Fork of the Merced River, into Lewis Creek, a tributary of the Fresno River. This exportation of water has been in existence since 1895, and all estimates of natural runoff for the Merced River contained in this report are under conditions of this diversion. It is estimated that during a year of average water supply, about 6,000 acre-feet are diverted from the Merced River Basin. This diversion is at a streambed elevation of about 5,600 feet, and has a capacity of about 50 second-feet.

Water Quality

The objectives of the water quality phase of the Mariposa Area Investigation were to determine the present quality of surface and ground water, to detect water quality problems, and to evaluate effects of future development upon the quality of water. The criteria which were used in evaluating suitability of water supplies for domestic, municipal, industrial, agricultural, and fish and wildlife purposes are included in Appendix B of

this report. The results of mineral analyses of surface and ground water are shown in Table 20, "Analysis of Surface Water in the Mariposa Area", and Table 21, "Analyses of Ground Water in the Mariposa Area".

Chemical Classification of Waters

Waters are classified with respect to mineral composition in terms of the predominant ions. Specifically, the name of an ion is used where it constitutes at least half of its ionic group, expressed in equivalent weights. Where no one ion fulfills the requirement, a hypenated combination of the two most abundant constituents is used. Thus a calcium bicarbonate water denotes that calcium constitutes at least half of the cations and bicarbonate represents at least half of the anions. Where the calcium is predominant but less than half and sodium is next in abundance, the name is modified to calcium-sodium bicarbonate.

Quality of Surface Water in the Mariposa Area

An evaluation of the surface water has been made for each of the three hydrographic units within the Mariposa area: the Merced River Unit, the Chowchilla River Unit, and the Eastern Merced County Stream Group Unit. To appraise the mineral quality of surface water in these areas, 17 streams and one reservoir were sampled. The results of analyzing samples from these sources are discussed below.

The Merced River Unit comprises about two-thirds of Mariposa County (the eastern and northwestern portions). The following surface water sources within the Merced River Unit were sampled: Maxwell Creek, Bean Creek, Whitlock Creek, Plumbar Creek, South Fork of the Merced River, and the Merced River. Water from these sources is of excellent mineral quality and is suitable for most beneficial uses. It is a calcium bicarbonate type water, with two exceptions: the water of Maxwell and Plumbar Creeks is a

calcium-magnesium bicarbonate type.

In the Chowchilla River Unit, which drains southeastern Mariposa County, the following intermittent tributaries were sampled: Pegleg Creek, Striped Rock Creek, and the West, Middle, and East Forks of the Chowchilla River. These tributaries contain water of excellent mineral quality suitable for most beneficial uses. Samples from these streams indicate that their water is a calcium-sodium bicarbonate type, except that of Pegleg Creek, a tributary to the West Fork of the Chowchilla River, which is a calcium bicarbonate type.

The Eastern Merced County Stream Group Unit consists of many small intermittent streams which flow westward from Mariposa County into Merced County. The following four streams in this drainage area were sampled: Burns Creek, Bear Creek, Owens Creek, and Mariposa Creek. In addition, Stockton Creek and Agua Fria Creek, both tributaries to Mariposa Creek, and Stockton Reservoir on Stockton Creek, were sampled. These sources yield water of excellent quality, suitable for most beneficial uses. Analyses of samples show that the water of Bear Creek, Owens Creek, Stockton Creek, and Stockton Reservoir is a calcium-magnesium-bicarbonate type; that of Burns and Mariposa Creeks is a magnesium-calcium bicarbonate type; and that of Agua Fria Creek is a calcium bicarbonate type.

Chemical classification of surface waters in the Mariposa area show that cation composition differs slightly for each of the three major surface water drainage units. The Merced River and its tributaries drain formations which are chiefly granitic; these formations are young geologically, relatively unweathered, and contain salts that are only slightly soluble. These factors cause Merced River waters to be low in dissolved salts, of which calcium salts predominate. The southwest portion of the investigational area is drained by

tributaries of the Chowchilla River, which also pass over granitic formations. These granitics, however, are older, more weathered, and contain larger quantities of soluble salts, predominantly the salts of sodium. Total dissolved solids are higher in these waters than those in the waters of the Merced River Basin. In the central portion of Mariposa County, the creeks originate in or pass through serpentine formations, thereby causing the presence of magnesium in their waters. Older granitic formations also contribute calcium salts to creeks in this area.

Ranges of concentrations of selected mineral constituents in surface water samples collected in the area of investigation are given in the following tabulations:

Constituent	Range
Conductance in micromhos @ 25°C.	12.5-522
Total dissolved solids in parts per million (ppm)	12-330
Boron in ppm	0.00-0.38
Percent sodium	5-46

Water with concentrations in the above range is excellent and suitable for most beneficial uses. Bean Creek, however, had iron in a concentration of 0.31 ppm which slightly exceeds the United States Public Health Service (USPHS) recommended limit of 0.3 ppm in drinking water.

Quality of Ground Water in the Mariposa Area

There are no significant ground water basins within the area of investigation. Water found at shallow depths is pumped from wells scattered throughout Mariposa County. Nine wells were sampled during the investigation; four of these were dug wells ranging in depth from 32 to 66 feet, and the others were both dug and drilled. It is probable that some of these wells,

particularly those that were dug, are springs that have been developed as sumps. In addition to the nine sampled wells, two springs were sampled to appraise the quality of ground water.

Analyses reveal that ground water generally reflects the mineral characteristics of surface water in the drainage area. The following tabulation gives the five chemical classifications of ground water found in the Mariposa area and the number of sampled sources in each classification.

Classification of Water	No. of Sources
Calcium bicarbonate	6
Calcium-magnesium bicarbonate	2
Calcium-sodium bicarbonate	1
Calcium-sodium sulfate-bicarbonate	1
Sodium chloride	1

Range and numerical average of selected mineral constituents from the 11 ground water sources sampled in the Mariposa area are as follows:

Constituent	Range	Average
Conductance in micromhos @ 25°C.	122-956	471
Total dissolved solids in ppm	107-529	312
Boron in ppm	0.01-0.19	0.05
Percent sodium	7-54	22
Fluoride in ppm	0.0-0.5	0.2
Hardness in ppm	42-339	184

The ground water is generally of excellent quality and suitable for most beneficial uses.

Water Quality Problems in the Mariposa Area

No significant water quality problems associated with mineral constituents were detected in the investigational area. The only deviation from the overall excellent mineral quality water was in Bean Creek which contained iron slightly in excess of the recommended USPHS limit. All other sources yielded water with mineral concentrations that were class 1 for irrigation and within the mandatory and recommended limits for drinking water.

A local problem occurs in the water supply system for the town of Mariposa. Water is supplied to this system from a reservoir which impounds runoff from Stockton Creek about one and a half miles north of town. Water from this reservoir is transported by a six-inch steel pipeline to a small distribution pond located a quarter of a mile above the town. In this distribution pond, algal growth of sufficient extent to impart a taste and odor to the water was detected. At present, water is chlorinated as it enters the ponds; however, this does not seem to be effective in controlling the algal growth.

Local authorities report that during the summer there have been complaints about pollution occurring in some streams. During the summer season, many creeks go dry or have extremely low flows; therefore, their waste assimilation capacity is nonexistent during some months. Moreover, low summer streamflow is conducive to algal growth. Algae may cause taste, odor, scum, and discoloration problems in water supplies. Since many variable factors affect the growth of algae, limiting criteria have not been established.

Effect of Future Development on Water Quality in the Mariposa Area

Present water quality conditions may be adversely affected by future growth and development in population, recreation, lumbering, agriculture, and mining. Growth in recreation activities and population will comprise most of the future development. Lumbering activities will expand little, if any, because of the large areas of national forests in the county. There are numerous mineral deposits found in the county and mining activities may increase if conditions become favorable to profitable operation. Suitable controls on wastes resulting from any of the previously mentioned activities should prevent serious problems from arising.

There are several proposed plans for the development of water resources in the Mariposa area. Increased storage on the Merced River by the Merced Irrigation District and reservoirs on Mariposa, Bear, Bean, and Maxwell Creeks for local requirements are some of the developmental plans under consideration. Based on available data, there would be no impairment of the quality of water due to proposed projects.

If any of the proposed water development projects were to include shallow reservoirs, algal blooms probably would develop during the warm summer months. Growth of algae might cause a maintenance problem in the operation of any physical works.

Operation of water conservation projects generally results in constant nominal reservoir releases during summer months. These flows would have a favorable effect on quality by maintaining discharges to prevent sluggish river flows and pooling in late summer and early fall. The relatively high summer and fall releases provide greater dilution and carry more dissolved oxygen for stabilization of organic wastes.

Water Quality Criteria

Criteria presented in Appendix B of this report can be utilized in evaluating mineral quality of water relative to existing or anticipated beneficial uses. It should be noted that these criteria are merely guides to the appraisal of water quality. Except in cases where the constituents are considered toxic to human beings, these criteria should be considered as suggested limiting values. A water which exceeds one or more of these limiting values need not be eliminated from consideration as a source of supply, but other sources of better quality should be investigated.

TABLE 3

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation			
							Maximum		Minimum	
							Year	Inches	Year	Inches
B6-0048	6S/21E-31	Ahwahnee	2,323	1950-57	USWB	27.59	1955-56	42.33	1952-53	21.93
BO-0371-01	8S/15E-29	Athlone	210	1885-98	USWB	11.57	1889-90	19.07	1897-98	6.47
B7-0379	10S/23E-8	Auberry	2,003	1915 to date	USWB	24.50	1937-38	45.02	1923-24	13.64
B5-0425	3S/21E-22	Badger Pass	7,300	1941 to date	USWB	51.51	1951-52	87.51	1954-55	37.14
B5-0430	4S/17E-6	Bagby	825	1958 to date	DWR	a	a	a	a	a
B5-0570	4S/17E-20	Bear Valley	2,000	1952 to date	DWR	25.86	1955-56	38.74	1956-57	15.85
BO-0632	6S/14E-31	Bellevue Ranch	200	1877 to date[b]	DWR	12.23	1957-58	26.81	1878-79	6.24
BO-0686-01	10S/17E-30	Berenda	256	1889-1900	DWR	10.11	1889-90	16.46	1899-00	8.12
B7-0755	8S/25E-28	Big Creek Powerhouse No. 1	4,930	1915 to date	USWB	31.12	1957-58	53.68	1923-24	15.86
B7-0755-01	8S/24E-25	Big Creek Powerhouse No. 2	3,000	1913 to date	SCEC	30.90	1937-38	51.98	1923-24	14.92
B7-0755-02	9S/24E-17	Big Creek Powerhouse No. 3	1,400	1922 to date	SCEC	25.91	1937-38	45.43	1923-24	11.53
B7-0755-03	9S/23E-20	Big Creek Powerhouse No. 4	1,000	1951 to date	SCEC	23.25	1955-56	36.93	1956-57	18.88
B7-0755-04	8S/24E-27	Big Creek Powerhouse No. 8	2,260	1921 to date	SCEC	27.30	1937-38	47.25	1923-24	14.39
B6-1151	8S/18E-28	Buchanan	450	1879-82		a	a	a	a	a

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation			
							Maximum		Minimum	
							Year	Inches	Year	Inches
BC-1580	6S/13E-32	Castle Air Force Base	170	1951 to date	USAF	11.29	1957-58	21.20	1958-59	6.73
B5-1588	6S/17E-24	Cathay-Bull Run Ranch	1,425	1940 to date	USWB	19.37	1958-59	31.84	1959-60	12.07
B5-1590	6S/17E-10	Cathay-Sawyer Ranch	1,300	1957 to date	DWR	a	a	a	a	a
B5-1591	6S/17E-14	Cathay-Stonehouse	1,210	1951 to date	DWR	19.73	1958-59	33.13	1959-60	11.92
B6-1611	5S/21E-30	Cedar Point Ranch	3,230	1957 to date	USWB	a	a	a	a	a
B7-1630	7S/23E-5	Central Camp	5,364	1940-48	USWB	46.03	1942-43	66.55	1943-44	34.98
B0-1748	10S/14E-8	Chowchilla Farms	150	1887-1938	DWR	8.74	1905-06	18.42	1923-24	4.23
B7-1844	5S/25E-6	Clover Meadows Gaging Station	7,002	1946 to date	USWB	41.95	1955-56	64.50	1946-47	30.78
B6-1878	8S/21E-5	Coarsegold	2,240	1952 to date	USWB	27.72	1955-56	44.75	1954-55	23.68
B5-2072	2S/16E-33	Coulterville Forestry Fire Station	1,870	1898[b]	Division of Forestry	a	a	a	a	a
B5-2072-05	2S/17E-33	Coulterville 5E	3,010	1959 to date	DWR	a	a	a	a	a
B7-2122	7S/22E-25	Crane Valley Powerhouse	3,500	1903 to date	PG&E	40.45	1937-38	69.39	1923-24	18.37
B4-2173	1S/19E-33	Crocker Station	4,700	1896-1953[b]	USWB	48.71	1900-01	75.04	1897-98	31.37
B6-2288	9S/18E-26	Daulton	410	1946 to date	DWR	13.00	1957-58	26.71	1946-47	5.46

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation: Maximum: Year	Maximum: Inches	Minimum: Year	Minimum: Inches
BC-2389	5S/11E-6	Denair	124	1917 to date	USWB	12.24	1957-58	21.41	1923-24	5.07
B4-2473	2S/14E-35	Don Pedro Reservoir	700	1940 to date	HHWD	20.24	1957-58	29.10	1958-59	11.58
B5-2539	2S/17E-21	Dudleys	3,000	1909 to date[b]	USWB	38.05	1910-11	57.18	1923-24	18.41
B4-2609	1S/18E-11	Early Intake Powerhouse	2,356	1925 to date	HHWD	32.12	1937-38	52.39	1958-59	19.97
B5-2920	4S/15E-13	Exchequer Reservoir	484	1935 to date	USWB	20.75	1955-56	29.66	1958-59	10.60
B7-3261	11S/21E-7	Friant Government Camp	410	1896 to date	USWB	13.41	1957-58	22.67	1897-98	5.91
B5-3435	2S/22E	Glacier Point	7,200	1920-23	USWB	a	a	a	a	a
B5-3586	2S/17E-32	Greeley Hill	3,160	1958 to date	DWR	a	a	a	a	a
B5-3613	2S/16E-12	Green Valley Ranch	3,170	1957 to date	DWR	a	a	a	a	a
B4-3666	1S/16E-21	Groveland	2,828	1929-54[b]	USWB	35.05	1910-11	59.75	1912-13	18.32
B4-3669	1S/16E-21	Groveland No. 2	2,825	1940 to date	USWB	a	a	a	a	a
B4-3666-01	1S/16E-21	Groveland Garotte	2,828	1904-15	DWR	a	a	a	a	a
B4-3668	1S/16E-26	Groveland Garotte No. 2	2,800	1883-1902	DWR	a	a	a	a	a
B4-3672	1S/17E-27	Groveland Ranger Station	3,135	1940 to date	USWB	36.78	1955-56	52.94	1958-59	24.70

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation: Maximum Year	Maximum Inches	Minimum Year	Minimum Inches
B4-3939	1N/20E-17	Hetch Hetchy	3,870	1910 to date	USWB	34.91	1937-38	55.62	1923-24	17.03
B0-3940	4S/11E-3	Hickman	105	1913-27	DWR	12.15	1921-22	16.58	1923-24	5.12
B5-3948	6S/19E-6	Hidden Valley	1,880	1949 to date	DWR	28.75	1957-58	47.33	1958-59	16.19
B5-4101	5S/17E-18	Hornitos-Erickson Ranch	1,150	1955 to date[b]	DWR	a	a	a	a	a
B5-4102	5S/16E-17	Hornitos Gagliardo	950	1923-59	DWR	18.08	1957-58	30.18	1958-59	9.16
B5-4103	5S/16E-29	Hornitos Giles Ranch	1,050	1939 to date	DWR	18.76	1957-58	32.11	1958-59	11.54
B5-4102-01	5S/16E-17	Hornitos (Merced Irrigation District)	945	1952 to date	DWR	a	1956-57	10.77	1957-58	26.10
B7-4176	8S/25E-22	Huntington Lake	7,020	1915 to date	USWB	31.60	1955-56	53.57	1923-24	15.70
B5-4246	6S/16E-3	Indian Gulch	1,000	1952 to date[b]	DWR	20.71	1955-56	27.25	1958-59	10.09
B4-4323-01	1S/15E	Jacksonville	700	1907-17	USWB	26.44	1910-11	38.28	1907-08	15.31
B6-4369	4S/19E-35	Jerseydale Guard Station	3,605	1958 to date	USFS	a	a	a	a	a
B5-4571	3S/18E	Kinsley	2,720	1914-16	USWB	a	a	a	a	a
B0-4590	1S/12E-27	Knights Ferry 2ESE	315	1905 to date	USWB	17.68	1957-58	26.08	1923-24	8.75
B0-4642	3S/14E-17	La Grange	300	1867-1953[b]	USWB	16.64	1889-90	30.34	1876-77	5.74
B4-4679	1N/19E-3	Lake Eleanor	4,662	1909 to date	USWB	42.54	1955-56	60.90	1923-24	20.83
B4-4687	2N/19E-17	Lake Lloyd		1953 to date	HHWD	a	a	a	a	a

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation: Maximum: Year	Maximum: Inches	Minimum: Year	Minimum: Inches
B5-4760	5S/15E-25	La Paloma Ranch		1935 to date[b]	DWR	19.94	1957-58	37.86	1946-47	9.52
B5-4883	7S/18E-7	Le Grand Preston Ranch	984	1950 to date	DWR	17.75	1951-52	28.20	1958-59	12.10
B0-4884	8S/16E-20	Le Grand	255	1899 to date	USWB	12.49	1957-58	22.58	1907-08	4.87
B5-4885	7S/17E-24	Le Grand-Turner Ranch	840	1953 to date	DWR	17.25	1957-58	26.90	1958-59	10.38
B0-4999	6S/11E-25	Livingston	130	1885-1939[b]	DWR	11.43	1889-90	19.65	1923-24	5.00
B0-4999.03	6S/11E-32	Livingston 5W	112	1952 to date	DWR	11.05	a	a	a	a
B0-5005	6S/11E-25	Livingston Police Station	130	1948 to date	DWR	a	a	a	a	a
B0-5004	6S/11E-31	Livingston 5W	112	1952 to date	DWR	11.05	1957-58	19.31	1952-53	8.17
B0-4999-01	6S/12E-20	Livingston (Near) Raisin	136	1921-22	USWB	a	a	a	a	a
B7-5040	7S/24E-3	Logan Meadow	3,000	1947 to date	USWB	a	1955-56	48.62	1952-53	21.81
B0-5233	11S/18E-13	Madera	270	1899 to date	USWB	10.01	1940-41	19.77	1923-24	5.49
B5-5346	5S/18E-23	Mariposa	2,011	1909 to date[b]	USWB	29.33	1910-11	46.81	1923-24	12.90
B5-5348	4S/19E-27	Mariposa Circle 9 Ranch	3,600	1957 to date	DWR	a	a	a	a	a
B5-5352	5S/18E-15	Mariposa Ranger Station	2,100	1943 to date	USWB	a	a	a	a	a
B6-5346-04	6S/20E-6	Mariposa 8ESE	2,780	1952 to date	DWR	32.31	1955-56	51.75	1954-55	22.96

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation			
							Maximum		Minimum	
							Year	Inches	Year	Inches
B4-5400	1S/19E-2	Mather	4,518	1930 to date[b]	USWB	33.81	1955-56	45.90	1958-59	23.57
B5-5460	2S/17E-33	McDermid Station	2,990	1959 to date	DWR	a	a	a	a	a
B7-5496	10S/23E-11	Meadow Lake	4,485	1948 to date	USWB	29.46	1951-52	42.42	1958-59	20.76
B0-5532	7S/14E-25	Merced Fire Station No. 2	169	1872 to date	USWB	11.91	1957-58	25.63	1897-98	5.76
B0-5535	7S/14E-19	Merced No. 2	168	1938 to date	USWB	a	a	a	a	a
B0-5541	5S/15E-4	Merced Falls	321	1907-50	USWB	15.40	1934-35	22.45	1923-24	8.20
B0-5534	7S/15E-29	Merced-Fanches Ranch	210	1920 to date	DWR	12.50	1957-58	22.71	1923-24	6.50
B4-5735	1S/15E	Moccasin	950	1935 to date	HHWD	27.04	1951-52	40.49	1946-47	18.71
B0-5791	4S/11E-36	Montpelier	225	1899-1927	DWR	12.37	1905-06	18.95	1923-24	5.49
B7-6252	8S/23E-18	North Fork Ranger Station	2,630	1904 to date	USWB	33.08	1908-09	61.59	1928-29	16.88
B5-6552	3S/22E	Ostrander Lake	8,600	1947 to date	USWB	47.89	1951-52	68.84	1958-59	36.10
B4-7145	1S/16E-31	Priest	2,245	1928 to date	HHWD	26.30	1957-58	42.47	1930-31	16.57
B6-7274	9S/19E-6	Raymond 3SSW	635	1940 to date[b]	DWR	13.52	1957-58	27.85	1948-49	7.45
B6-7273	6S/19E-35	Raymond Bar 7 Ranch	1,150	1957 to date	DWR	a	a	a	a	a
B6-7272	6S/19E-33	Raymond Whipple Ranch	1,380	1957 to date	USWB	23.93	a	a	a	a

(Continued)

TABLE 3 (Continued)

RECORDED MAXIMUM, MINIMUM AND ESTIMATED MEAN ANNUAL PRECIPITATION AT STATIONS IN THE MARIPOSA AREA

D.W.R. reference number	Location TS, R, & Sec MDB&M	Station name	Elevation, in feet	Period of record	Source of record	Estimated mean annual precipitation, in inches	Recorded annual precipitation			
							Maximum		Minimum	
							Year	Inches	Year	Inches
B6-7276	6S/19E-25	Raymond 12NNE	1,600	1954 to date	DWR	25.62	1955-56	41.00	1958-59	14.59
B7-7817	10S/21E-6	San Joaquin Experiment Ranch	1,100	1934 to date	USWB	17.64	1957-58	32.07	1958-59	10.11
B0-8316	5S/14E-4	Snelling	259	1882-1938[b]	DWR	13.71	1889-90	29.99	1912-13	7.27
B5-8318	1S/23E-19	Snow Flat	8,700	1947 to date	USWB	51.08	1955-56	72.05	1958-59	33.20
B5-8615	2S/15E-34	Sturtevant Ranch	1,450	1953 to date	UCD	20.18	1957-58	33.02	1954-55	15.42
B6-8646	5S/21E-23	Summerdale	5,270	1896-1933[b]	USWB	47.94	1900-01	85.46	1932-33	24.10
B5-8380	5S/21E-12	South Entrance Yosemite National Park	5,120	1941 to date	USWB	44.10	1957-58	64.64	1946-47	24.92
B4-9063	1S/24E-3	Tuolumne Meadows	8,600	1947 to date	USWB	32.09	1951-52	47.33	1948-49	21.33
B6-9329	8S/16E-33	Vignola Ranch	440	1933-39	DWR	13.53	1934-35	21.70	1933-34	8.95
B0-9462	3S/11E-28	Waterford	160	1899-1930	DWR	12.89	1906-07	18.92	1923-24	4.91
B5-9482	4S/21E-34	Wawona Ranger Station	3,975	1934 to date	USWB	38.91	1937-38	70.50	1948-49	23.38
B5-9855	2S/22E-20	Yosemite National Park	3,985	1904 to date	USWB	35.92	1937-38	58.64	1923-24	14.77

[a] Record inadequate
[b] Record not continuous

TABLE 4

RECORDS OF MONTHLY PRECIPITATION GATHERED UNDER THE MARIPOSA AREA INVESTIGATION

D.W.R. reference number	Location TS, R, & Sec. MDB&M	Station name	Elevation, in feet	Precipitation period	Precipitation in inches July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
B5-0430	S6,T4S,R17E	Bagby - H.B. Clark	2,000	1958-59	NR[1]	NR	NR	NR	NR	NR	4.40	5.65	.94	1.94	.24	0	Inc.[2]
				60	0	0	4.27	0	0	1.12	5.25	5.72	4.04	3.07	0	0	23.47
				61	0	0	.17	.20	4.48	1.62	2.05	1.36	3.22	1.25	1.45	0	15.80
				62	.10	0	.16	.08	3.40	2.03	2.02	16.17	3.84	.31	.22	0	28.33
				63	.20	0	.05	2.50	.57	3.08	4.55	3.25	5.39	6.17	0	T[3]	25.76
B5-0570	S20,T4S,R17E	Bear Valley - Trabucco	2,030	1952-53	0	0	0	0	2.78	10.56	4.06	0.11	3.01	2.97	0	0	23.49
				54	0	0	0	0	3.50	1.51	4.85	4.59	7.32	3.78	0	0	25.55
				55	0	0	0	0	2.69	4.52	6.39	2.85	0.15	3.68	1.59	0	21.87
				56	0	0	0	0	2.21	20.78	8.41	2.44	0.10	4.09	0.62	0	38.65
				57	0	0	0	0	0	1.06	4.18	4.69	3.66	2.26	0	0	15.85
				58	0	0	0	0	1.38	5.50	6.55	5.91	10.37	5.34	0	0	35.05
				59	0	0	.54	.10	0	.73	6.30	5.89	1.08	2.83	.38	0	17.85
				60	0	0	6.13	0	0	1.17	5.78	7.01	4.10	2.93	.15	0	27.27
				61	0	0	0	.57	5.96	2.31	2.13	1.79	3.05	1.23	1.22	.03	18.29
				62	T	T	.30	0	3.92	2.63	2.28	13.34	4.23	.42	.10	.13	27.35
				63	0	0	.15	2.65	.75	3.64	4.56	3.04	2.88	6.99	1.15	0	25.81
B6-1590	S1C,T6S,R17E	Cathay - Sawyer Ranch	1,300	1957-58	NR	NR	NR	NR	NR	4.33	4.41	4.84	7.25	5.15	1.47	.07	Inc.
				59	T	T	0.33	T	0.25	0.24	4.04	4.47	0.44	1.18	0.17	0	11.12
				60	0	0	2.20	0	0	0.69	3.99	4.64	3.01	2.20	0.24	0	16.97
				61	0	0	T	.23	4.26	1.17	2.03	1.44	1.97	.88	1.25	T	13.23
				62	.20	.02	.08	.05	1.90	2.05	2.15	9.39	3.18	.40	.03	.02	19.47
				63	.03	.01	.03	2.00	.39	2.72	3.54	4.45	4.27	5.36	2.50	.02	25.32
B6-1591	S14,T6S,R17E	Cathay - Stonehouse, Spurgin	1,210	1951-52	NR	NR	NR	NR	NR	NR	8.55	1.80	6.83	3.32	0.15	0	Inc.
				53	0.15	0.05	0.25	0	2.45	8.50	3.05	0.55	1.60	3.04	0.31	0.91	21.46
				54	0	0	0	0.65	3.55	1.80	4.07	3.55	7.15	1.20	0	0.42	22.39
				55	0	0	0	0	2.20	4.02	5.40	2.05	0.10	2.72	1.40	0	17.89
				56	0	0	0	0.07	2.45	13.25	4.35	1.07	0.03	2.35	1.30	0	25.37
				57	0	0	0.11	1.62	0	0.57	3.35	2.72	3.65	2.00	4.65	0.20	18.88
				58	0	0	0.70	1.22	1.58	4.95	4.90	5.65	7.78	5.15	1.15	0.05	33.13
				59	0.01	0	0.31	0	0.17	0.35	4.52	4.45	0.29	1.55	0.27	0	11.92
				60	0	0	3.00	0	0	0.66	3.70	4.78	2.45	2.09	0.18	0	16.87
				61	0	0	.05	.18	4.50	1.43	1.97	1.25	1.96	.80	1.27	0	13.42
				62	.27	.04	.10	.08	2.58	1.93	2.27	10.07	2.97	.20	0	.02	20.53
				63	0	0	0	2.12	.33	2.92	3.90	4.13	3.70	5.14	.93	.02	23.24
B5-2072-05	S33,T2S,R17E	Coulterville SE - Jacnecke	3,010	1958-59	NR	NR	NR	NR	NR	NR	NR	RB[4]	1.41	1.61	0.46	0	Inc.
				60	0	0	6.58	0	0	1.41	6.58	NR	NR	NR	NR	NR	Inc.
				61	0	0	.11	.38	5.75	2.02	2.62	1.90	4.63	1.55	.88	.38	20.22
				62	.17	T	.27	.50	3.92	3.60	2.70	19.02	5.23	.90	.25	.09	36.56
				63	.23	0	.12	2.32	.73	3.56	11.34	5.26	5.28	7.58	1.99	.15	39.08

(Continued)

TABLE 4 (Continued)

RECORDS OF MONTHLY PRECIPITATION GATHERED UNDER THE MARIPOSA AREA INVESTIGATION

D.W.R. reference number	Location TS, R, & Sec. MDB&M	Station name	Elevation, in feet	Precip-itation period	Precipitation in inches July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
B5-3612-03	S7,T2S,R17E	Green Valley Ranch - Davidson	3,150	1957-58	NR	NR	NR	NR	NR	RB	6.01	7.70	11.66	6.59	1.05	0.30	Inc.
				59	0	0	0.48	0.07	0.89	1.23	7.40	6.11	1.33	1.76	0.40	0	19.57
				60	0	T	4.95	0	0	1.38	6.98	10.70	4.82	3.71	0.13	0	32.57
				61	T	0	.35	.45	5.67	2.12	2.20	2.29	3.52	1.67	1.35	.35	20.07
				62	.02	T	.40	.42	4.22	3.21	2.61	17.12	6.42	1.28	.19	T	35.89
				63	.28	T	T	3.46	.85	3.22	6.08	8.98	5.68	8.23	2.13	.57	39.48
B6-3948	S6,T6S,R19E	Hidden Valley - Brady	1,870	1949-50	0	0	0	0.10	3.43	NR	NR	NR	NR	NR	NR	NR	Inc.
				51	0	0	*5/	*	14.10	6.55	2.65	5.42	1.90	1.98	0.25	0	32.85
				52	0	0	0	2.40	3.98	9.77	12.33	2.07	9.30	2.43	0	0	42.28
				53	0	0	0	0	2.94	10.01	4.52	1.07	1.75	2.81	1.11	0.94	25.16
				54	0	0	0.04	0.71	3.20	1.48	4.38	5.05	7.52	2.80	0.09	0.83	26.11
				55	0	0	0	0.71	2.27	4.01	5.90	2.56	0.30	3.49	2.32	0	21.56
				56	0	0	0	0.05	3.65	23.15	6.71	2.27	T	4.99	2.05	0	42.87
				57	0	0	0.03	1.86	0	1.11	3.77	3.77	4.35	2.29	3.88	0.05	21.12
				58	0	0	0.25	1.52	1.43	6.21	6.02	9.89	12.65	7.94	1.27	0.13	47.33
				59	0	0	0.30	0	0.48	0.38	6.47	8.04	0.19	0	.33	0	16.19
				50	T	T	5.62	0	0	1.00	4.48	2.60	3.58	3.45	.20	0	21.04
				61	T	0	.04	.38	6.31	1.28	2.41	.90	3.60	1.08	1.03	.07	17.10
				62	.14	0	.16	.10	3.83	3.17	3.50	16.57	4.45	.42	.24	.05	32.54
				63	.09	0	.09	2.75	.58	3.22	7.31	6.93	5.41	7.79	.88	.12	35.17
B5-4102-01	S18,T5S,R17E	Hornitos - Erickson Ranch	1,150	1955-56	0	0	0	0	8.30	11.10	6.05	2.00	0	2.90	1.25	0	31.60
				57	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
				58	NR	NR	NR	NR	NR	3.02	5.07	5.32	7.51	5.19	1.34	0.05	Inc.
				59	0	0	0.32	0	0.18	0.40	4.64	4.55	0.40	1.84	0.20	0	12.53
				60	0	0	2.88	0	0	0.75	4.18	4.52	3.30	2.69	0.10	0	18.52
				61	0 6/	0 6/	0 6/	.25	4.38	1.16	2.06	1.35	2.32	.90	1.13	.01	13.56 7/
				62	.13	0 6/	0 6/	0 6/	2.96	2.12	2.09	10.23	2.85	.46	0 6/	0 6/	20.84 7/
				63	.15	0 6/	.10	2.00	.51	2.97	2.42	5.75	4.55	5.07	.64	0 6/	24.17 7/
B5-4103	S29,T5S,R16E	Hornitos - Giles Ranch	1,050	1939-40	.25	.10	.02	2.80	.83	9.73	7.75	5.91	4.09	.62	0	0	32.11
				41	0	0	0	.81	.32	8.13	2.68	6.13	2.31	5.07	.34	0	25.79
				42	0	.04	0	1.11	1.11	5.96	3.44	2.57	2.17	3.94	1.14	0	21.48
				43	0	0	0	.17	2.03	1.90	2.81	2.51	7.82	1.18	0	0	18.52
				44	0	0	0	.59	.80	2.04	3.34	5.21	1.25	2.17	.45	.37	16.22
				45	0	0	.13	1.03	5.04	2.28	.15	5.29	4.04	.40	.22	.10	18.68
				46	0	0	0	2.48	2.84	5.14	1.00	2.32	3.32	.13	1.03	0	18.26
				47	0	0	0	1.07	4.29	3.52	.61	1.30	1.78	.57	.50	.15	13.89
				48	0	0	0	1.44	.81	.75	.17	1.88	4.78	3.68	1.70	0	15.21
				49	0	0	0	.65	.38	3.17	1.73	2.55	4.93	0	.52	0	13.94

(Continued)

TABLE 4 (Continued)

RECORDS OF MONTHLY PRECIPITATION GATHERED UNDER THE MARIPOSA AREA INVESTIGATION

D.W.R. reference number	Location TS, R, & Sec. MDB&M	Station name	Elevation, in feet	Precip-itation period	Precipitation in inches July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
B5-4103 (Continued)				1950	0	0	0	0	1.27	1.73	5.87	2.47	1.93	1.05	.20	0	14.52
				51	0	0	.55	2.62	6.79	4.82	3.15	2.15	1.38	1.24	.55	0	23.25
				52	0	0	0	2.25	2.08	5.04	6.55	1.57	4.74	3.07	.28	0	25.58
				53	0	.10	.15	.25	1.75	6.47	2.15	.15	1.99	.23	2.83	.70	16.77
				54	0	0	0	.50	1.87	1.28	3.47	2.95	5.63	1.30	.35	.58	18.23
				55	0	0	0	0	1.45	3.03	4.35	1.91	.20	2.50	1.55	0	15.49
				56	0	0	0	0	1.86	13.70	4.87	1.71	0	2.91	1.05	0	26.10
				57	0	0	.32	.77	0	.42	3.55	2.75	2.55	1.69	2.85	0	15.00
				58	0	0	.25	1.20	.95	4.12	4.71	5.30	8.90	4.95	1.23	0	31.51
				59	0	0	.35	0	.35	.25	4.67	3.45	.34	1.41	.22	0	11.54
				60	0	0	2.15	0	0	.85	4.09	4.29	2.63	2.72	.07	0	16.80
				61	T	0	.35	.12	3.49	1.03	2.34	1.39	3.11	.86	1.32	.25	14.26
				62	.10	.01	.06	T[3/]	3.17	1.77	2.29	9.17	2.11	.31	.09	.03	19.11
				63	.05	.00	.05	1.64	.35	2.68	3.59	2.83	3.57	4.54	.78	.05	20.14
B5-4246	S3, T6S, R15E	Indian Gulch - Solari	1,000	1951-52	NR	NR	NR	NR	NR	NR	5.12	1.82	5.98	3.53	.30	0	Inc.
				53	0	0	.20	.18	1.82	7.77	3.02	.48	1.38	3.08	.77	.90	19.50
				54	0	0	0	.73	2.35	1.55	3.66	2.05	5.33	1.50	0	0	17.27
				55	0	0	0	0	1.73	3.55	4.97	1.75	.18	2.25	1.15	0	15.58
				56	0	0	0	.05	1.95	15.10	5.01	1.49	0	2.52	1.13	0	27.25
				57	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
				58	NR	NR	NR	NR	NR	2.40	4.31	4.77	6.78	4.34	1.51	.07	Inc.
				59	.02	0	.34	0	.28	.34	3.65	3.34	.47	1.50	.15	0	10.09
				60	NO RECORD FOR THE 1959-60 CLIMATOLOGICAL YEAR												
				61	0	0	.12	.22	4.21	.37	1.91	1.17	2.22	.84	1.23	0	12.29
				62	.08	0[6/]	0	.01	2.74	1.74	1.30	8.00	2.27	.25	.03	.03	16.45
				63	0[6/]	0[6/]	.10	1.50	.36	2.96	1.98	4.78	3.57	4.65	.72	.05	20.77[7/]
B6-5346-04	S6, T6S, R20E	Mariposa 8ESE - Boyce		1952-53	NR	NR	NR	NR	RR[4/]	4.48	5.36	.10	2.85	4.45	1.55	1.50	Inc.
				54	0	0	T	.90	.40	1.90	8.44	3.45	7.48	3.30	.15	1.40	27.42
				55	0	0	0	0	3.47	5.22	4.95	2.32	.35	3.95	2.70	0	22.96
				56	0	0	0	3.10	3.15	25.82	8.70	2.10	0	5.45	3.43	0	51.75
				57	0	0	.20	3.20	0	2.10	3.00	6.00	6.30	3.83	6.95	.20	31.78
				58	0	0	.40	2.80	0	1.30	7.50	10.10	11.20	8.70	2.10	.12	44.22
				59	NR	NR	NR	NR	NR	NR	NR	7.55	.70	2.40	.67	0	Inc.
				60	0	.15	5.05	0	0	.87[6/]	4.92	7.46	4.40	3.55	.40	0	25.81[7/]
				61	T	0	.12	.94	7.80	1.99	2.43	2.37	3.79	1.51	1.69	.21	22.85
				62	.05	T	.12	.22	3.84	3.60	2.31	17.96	4.55	.72	.58	.05	34.01
				63	.24	T	.16	3.25	.73	2.12	5.19	8.18	5.51	9.94	1.51	.10	37.03

(Continued)

TABLE 4 (Continued)

RECORDS OF MONTHLY PRECIPITATION GATHERED UNDER THE MARIPOSA AREA INVESTIGATION

D.W.R. reference number	Location TS, R, & Sec. MDB&M	Station name	Elevation, in feet	Precip-itation period	Precipitation in inches July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
B5-5348	S27,T4S,R19E	Mariposa - Circle 9 Ranch	3,650	1957-58	NR	NR	NR	NR	NR	RB	7.87	11.01	13.50	9.00	1.54	.50	Inc.
				59	0	T	1.10	0	.78	.86	7.83	9.87	.87	3.30	.94	0	25.55
				60	0	0	6.85	0	0	1.99	7.52	9.54	5.76	4.67	.21	0	36.54
				61	0	0	.30	1.50	7.09	2.55	2.83	2.11	4.99	1.86	1.97	0	25.30
				62	.14	0	.31	.32	4.57	4.21	3.53	22.69	7.27	1.02	.70	.13	44.99
				63	.22	.02	.19	3.30	.93	2.14	11.39	11.76	6.17	11.14	3.04	.17	50.47
B5-5352	S15,T5S,R18E	Mariposa Ranger Station - CDF	2,150	1957-58	0	0	.51	1.64	1.46	5.38	6.11	7.88	9.22	7.53	1.48	.10	41.31
				59	0[6]	0[6]	.62	0[6]	.39	.46	6.45	6.73	.56	1.98	.58	0	17.77[7]
				60	0	0	5.52	0	0	.96	6.03	7.18	3.87	3.87	.15	0	26.58
				61	0	0	0	.47	4.57	1.67	2.46	1.27	2.94	1.08	1.39	0	15.85
				62	0	0	0	0	1.97	3.05	3.28	15.55	4.02	.47	.04	.01	28.49
				63	0	.02	0	2.82	.44	3.43	7.89	6.23	5.44	8.09	1.27	.35	35.98
B6-7276	S25,T6S,R19E	Raymond 12NNE - Schatz (Victor Gage)	1,600	1953-54	NR	NR	NR	NR	NR	RB	3.60	2.35	5.35	1.90	T	.90	Inc.
				55	0	0	0	0	2.70	4.10	5.50	2.00	.45	4.15	1.50	0	20.40
				56	0	0	0	.25	4.55	19.80	6.85	1.50	.45	5.45	2.05	0	41.00
				57	0	0	0	1.85	0	1.35	3.05	3.85	3.55	2.70	4.95	0	21.30
				58	0	0	0	1.60	1.80	4.10	5.40	7.55	8.42	4.85	1.17	.10	34.99
				59	0	0	.45	0	.71	.65	4.25	5.52	.46	1.85	.60	0	14.59
				60	0	T	3.92	0	0	.80	3.84	6.42	3.01	2.88	.20	0	21.07
				61	0	0	.04	.57	5.85	1.31	2.29	1.75	2.10	1.05	1.26	0	16.22
				62	0	0	.05	.14	2.75	2.35	1.86	12.59	2.71	.41	.22	T	23.18
				63	.22	0	.02	1.80	.42	1.25	8.15	2.81	4.52	6.23	1.10	.05	26.58

1/ NR = No record.
2/ Inc. = Incomplete.
3/ T = Trace.
4/ RB = Record began.
5/ * = Included in following amount.
6/ Estimated
7/ Partially estimated.

TABLE 5

MEAN MONTHLY PRECIPITATION IN THE MARIPOSA AREA 1/
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Auberry B7-0379 2,003 feet	.04	.02	.27	1.06	2.18	4.15	4.94	4.47	4.20	2.11	.90	.16	24.50
Big Creek Powerhouse No. 1 B7-0755 4,930 feet	.07	.10	.44	1.43	2.69	5.08	6.02	5.33	5.07	2.94	1.53	.42	31.12
Crane Valley Powerhouse B7-2122 3,500 feet	.04	.05	.44	1.63	3.52	6.94	8.47	7.43	6.65	3.38	1.57	.33	40.45
Denair B0-2389 124 feet	.01	.01	.10	.48	1.06	2.33	2.54	1.89	2.21	1.03	.48	.10	12.24
Dudleys B5-2539 3,000 feet	.02	.02	.39	1.60	3.67	6.33	7.79	7.30	6.19	3.07	1.37	.30	38.05
Early Intake Powerhouse B4-2609 2,356 feet	.12	.08	.45	1.74	3.01	5.09	6.03	5.11	5.34	2.81	1.66	.68	32.12
Exchequer Reservoir B5-2920 484 feet	.01	.01	.18	.95	1.98	3.40	4.42	3.93	3.48	1.59	.64	.16	20.75

1/ Based on or corrected to the 50-year period from 1905-06 through 1954-55

(Continued)

TABLE 5 (Continued)

MEAN MONTHLY PRECIPITATION IN THE MARIPOSA AREA
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Friant Government Camp B7-3261 410 feet	0	0	.12	.60	1.22	2.24	2.90	2.40	2.35	1.08	.41	.09	13.41
Hetch Hetchy B4-3939 3,870 feet	.13	.09	.49	1.89	3.27	5.53	6.56	5.55	5.81	3.05	1.80	.74	34.91
Huntington Lake B7-4176 6,954 feet	.09	.13	.49	1.49	2.77	5.00	6.04	5.42	5.02	2.70	1.52	.46	31.13
Knights Ferry 2SE B0-4590 315 feet	0	0	.23	.80	1.96	3.24	3.68	3.12	3.02	1.43	.55	.14	18.17
Lake Eleanor B4-4679 4,662 feet	.08	.15	.52	2.07	4.02	6.97	8.45	7.40	6.78	3.50	1.91	.69	42.54
Le Grand B0-4884 255 feet	.01	0	.13	.56	1.23	2.22	2.53	2.18	2.13	.99	.44	.07	12.49
Madera B0-5233 270 feet	.01	.01	.08	.45	.89	1.71	1.98	1.84	1.74	.89	.34	.07	10.01

(Continued)

TABLE 5 (Continued)

MEAN MONTHLY PRECIPITATION IN THE MARIPOSA AREA
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Mariposa B5-5346 2,011 feet	.02	.01	.26	1.35	2.80	4.80	6.25	5.56	4.91	2.23	.91	.23	29.33
Merced Fire Station No. 2 B0-5532 169 feet	.01	.01	.12	.47	1.15	2.03	2.46	2.12	1.99	1.03	.44	.08	11.91
North Fork Ranger Station B7-6252 2,630 feet	.05	.04	.35	1.41	2.97	5.54	6.90	6.05	5.53	2.69	1.28	.27	33.08
Ostrander Lake B5-6552 8,600 feet	.13	.04	.43	2.21	4.60	8.27	9.65	8.34	7.93	3.91	1.82	.56	47.89
Sonora B4-8353 1,830 feet	.01	.01	.23	1.45	2.99	5.15	6.37	5.56	5.48	2.56	1.17	.33	31.31
South Entrance Yosemite National Park B5-8380 5,120 feet	.09	.04	.43	1.96	4.10	7.50	9.05	7.87	7.34	3.59	1.69	.44	44.10

TABLE 5 (Continued)

MEAN MONTHLY PRECIPITATION IN THE MARIPOSA AREA
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Yosemite National Park B5-9855 3,985 feet	.26	.16	.57	1.95	3.37	6.39	6.76	6.04	5.22	2.99	1.57	.64	35.92

TABLE 6

AVERAGE ANNUAL SNOWFALL IN THE MARIPOSA AREA[1/]
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Big Creek Powerhouse No. 1 B7-0755 4,930 feet	0	0	T	.3	4.8	16.6	26.6	21.9	26.9	8.1	.7	0	105.9
Denair B0-2389 124 feet	0	0	0	0	0	0	0	T	T	0	0	0	T
Dudleys B5-2539 3,000 feet	0	0	0	T	.9	6.4	15.5	9.4	9.4	1.2	T	0	42.8
Groveland B4-3666 2,828 feet	0	0	0	T	.2	3.7	8.4	4.3	4.2	.8	.2	T	21.8
Hetch Hetchy B4-3939 3,870 feet	0	0	0	.3	2.9	16.3	24.1	21.2	21.3	5.3	.3	T	91.6
Huntington Lake B7-4176 6,954 feet	0	0	.3	4.0	17.2	44.8	52.6	55.1	55.4	24.0	5.9	.2	259.5
Le Grand B0-4884 255 feet	0	0	0	0	0	T	T	0	0	0	0	0	T

(Continued)

TABLE 6 (Continued)

AVERAGE ANNUAL SNOWFALL IN THE MARIPOSA AREA[1/]
(In inches)

Station name, state number and elevation	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
Mariposa B5-5346 2,011 feet	0	0	0	0	0	.7	2.5	1.7	1.1	0	0	0	6.0
Merced Fire Station No. 2 B0-5532 169 feet	0	0	0	0	0	0	0	T	T	0	T	0	T
Merced Falls B0-5541 321 feet	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Ranger Station B7-6252 2,630 feet	0	0	0	T	.1	2.7	6.3	4.6	2.9	.5	T	0	17.1
South Entrance Yosemite National Park B5-8380 5,120 feet	0	0	T	T	7.2	26.4	30.7	25.5	44.4	10.3	2.1	.2	146.8
Wawona Ranger Station B5-9482 3,975 feet	0	0	0	.1	.6	11.0	24.8	17.4	16.3	3.8	.1	0	74.1
Yosemite National Park B5-9855 3,985 feet	0	0	T	.1	2.4	18.8	27.7	21.3	17.3	3.2	.3	0	91.1

1/ Based on or corrected to the 50-year period from 1905-06 through 1954-55.

TABLE 7

AVERAGE DEPTH OF SNOW AND WATER CONTENT IN THE MARIPOSA AREA[1/]
(In inches)

Snow course name	Snow course number	Elevation, in feet	February 1 average		March 1 average		April 1 Average		May 1 average	
			Depth	Water content	Depth	Water content	Depth	Water content	Depth	Water content
Rafferty Meadows	158	9,600	56.2	16.4	----	----	81.0	30.2	----	----
Tuolumne Meadows	161	8,600	43.6	13.6	59.8	19.7	57.3	22.6	39.8	20.3
Fletcher Lake	175	10,300	53.5	18.0	62.3	22.4	84.7	33.6	60.6	28.3
Snow Flat	176	8,700	76.4	25.3	100.5	34.9	105.7	42.5	80.2	40.6
Ostrander Lake	177	8,200	62.3	20.5	80.2	28.5	85.9	34.8	61.1	27.8
Lake Tenaya	178	8,150	56.4	15.5	74.4	26.9	77.1	34.0	52.4	30.2
Gin Flat	179	7,100	63.0	21.2	78.2	29.8	81.7	34.5	57.1	26.5
Peregoy Meadows	180	7,000	62.4	18.8	79.0	26.2	86.3	32.6	71.0	30.1
Cora Lakes	193	8,400	62.0	18.8	94.6	32.3	84.5	34.7	----	----
Chiquito Creek	202	6,800	51.7	15.4	----	----	52.5	21.3	----	----
Beasore Meadows	203	6,800	49.8	17.1	----	----	63.2	27.6	----	----

Note: ---- = No data.

1/ These estimated average values for the 50-year period 1905-06 through 1954-55 are the result of a considerable amount of generalization. The annual values are characterized by a wide range of variation.

TABLE 8

ANNUAL VARIATION OF TEMPERATURES IN THE MARIPOSA AREA
(In degrees Fahrenheit)

Station name and elevation	Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Years of record
Auberry	Highest	74	87	80	93	100	107	112	114	105	99	87	80	114	19
2,003 feet	Lowest	5	19	24	25	29	37	42	44	33	22	21	18	5	19
	Avg. Max.	55.0	56.8	61.5	70.1	79.7	87.8	96.5	94.7	89.1	77.6	66.0	57.5	74.4	19
	Avg. Min.	31.4	34.2	36.9	42.1	47.3	53.2	60.7	59.5	54.7	46.3	36.8	33.4	44.3	19
Big Creek Powerhouse	Highest	68	73	74	84	92	94	99	99	96	88	80	75	99	22
No. 1	Lowest	1	8	11	18	24	31	46	44	34	23	14	10	1	22
4,900 feet	Avg. Max.	48.1	50.3	54.1	50.0	66.4	73.6	83.4	82.9	78.5	68.3	58.1	49.8	64.5	22
	Avg. Min.	30.5	31.1	34.0	39.5	45.7	51.5	59.8	59.8	55.4	46.4	38.8	33.6	43.3	22
Cathay Bull Run Ranch	Highest	70	78	78	88	94	107	109	106	109	95	73	78	109	5
1,425 feet	Lowest	19	30	27	28	33	37	44	44	42	30	20	20	19	5
	Avg. Max.	54.6	57.9	63.3	69.3	77.1	88.3	95.0	94.9	89.1	78.3	66.3	58.4	74.4	5
	Avg. Min.	34.8	37.3	38.7	41.2	47.6	54.4	60.5	59.5	55.5	47.6	37.0	34.5	45.7	5
Denair	Highest	75	82	91	102	108	110	116	110	113	101	88	72	116	52
124 feet	Lowest	16	22	24	23	30	37	40	41	38	24	22	15	15	52
	Avg. Max.	53.6	59.9	66.5	74.2	82.3	88.9	95.4	93.0	88.0	78.0	65.7	55.1	75.1	22
	Avg. Min.	36.2	38.9	41.2	45.7	50.3	54.6	58.6	56.6	53.8	47.4	39.6	37.5	46.7	22
Dudleys	Highest	75	78	79	86	92	101	106	107	102	95	87	79	107	17
3,000 feet	Lowest	-10	-6	8	18	23	26	32	30	22	15	12	1	-10	17
	Avg. Max.	52.2	54.3	58.9	65.4	73.4	81.1	91.1	89.9	84.8	73.4	62.8	54.8	70.2	17
	Avg. Min.	25.0	27.0	30.4	34.5	38.8	42.6	47.0	45.2	41.4	35.8	29.4	27.0	35.3	17
Friant Government	Highest	74	81	86	97	107	112	116	113	112	101	92	78	116	13
Camp	Lowest	17	24	24	32	34	41	47	47	35	29	28	20	17	13
410 feet	Avg. Max.	55.7	61.2	65.7	74.6	85.5	93.0	101.3	99.0	93.6	81.5	68.2	57.4	78.1	13
	Avg. Min.	35.5	39.0	41.2	45.6	51.1	55.6	61.5	59.1	56.0	49.6	41.6	37.8	47.3	13
Huntington Lake	Highest	64	66	66	70	79	84	87	89	85	80	73	72	89	22
7,020 feet	Lowest	-18	-10	-7	3	6	23	34	33	25	16	1	-3	-18	22
	Avg. Max.	41.5	40.9	44.1	49.4	56.2	64.0	73.5	73.2	68.0	58.2	50.5	44.0	55.3	22
	Avg. Min.	18.7	18.1	20.7	26.7	33.6	40.4	48.3	47.7	43.5	36.0	29.1	24.2	32.3	22
Le Grand	Highest	79	82	86	98	112	115	117	114	111	100	92	78	114	51
255 feet	Lowest	11	21	24	28	30	32	35	40	33	26	20	11	11	49
	Avg. Max.	54.0	59.9	66.2	75.5	84.9	92.3	99.7	97.4	91.7	80.2	66.9	55.7	77.0	21
	Avg. Min.	35.9	39.1	40.8	45.1	50.4	55.8	60.4	58.2	54.0	47.3	36.9	35.9	46.9	19

(Continued)

TABLE 8 (Continued)

ANNUAL VARIATION OF TEMPERATURES IN THE MARIPOSA AREA
(In degrees Fahrenheit)

Station name and elevation	Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Years of record
Madera	Highest	72	83	96	99	110	111	115	114	112	100	92	79	115	51
270 feet	Lowest	10	20	24	28	31	33	38	35	32	24	22	16	10	50
	Avg. Max.	54.5	61.0	67.7	76.4	85.2	91.9	99.6	97.5	92.3	81.0	67.3	56.3	77.6	21
	Avg. Min.	35.4	38.7	40.9	45.0	50.0	54.9	59.8	57.8	53.5	46.8	39.0	36.9	46.5	20
Merced Fire Station	Highest	77	84	87	96	109	111	116	114	110	102	90	76	116	55
No. 2	Lowest	16	21	23	28	32	40	40	41	35	28	21	16	16	55
169 feet	Avg. Max.	53.9	59.7	66.1	74.5	83.0	89.8	97.2	95.1	90.0	79.3	66.4	55.4	75.9	21
	Avg. Min.	34.5	37.7	40.3	45.0	50.5	55.6	60.1	57.6	53.8	46.5	37.8	36.2	45.9	21
North Fork Ranger	Highest	74	77	80	88	96	106	109	111	110	98	88	76	111	17
Station	Lowest	5	13	16	26	26	32	44	42	33	25	21	4	4	18
2,630 feet	Avg. Max.	52.3	54.5	59.3	66.1	74.2	84.2	95.1	93.6	87.9	75.7	63.7	55.1	71.8	18
	Avg. Min.	30.2	32.6	35.7	40.6	45.8	51.0	58.7	57.9	52.7	45.2	37.0	32.8	43.4	18
South Entrance Yosemite	Highest	73	73	73	83	89	96	95	102	98	87	80	70	102	9
National Park	Lowest	-3	1	3	12	15	25	31	30	23	14	11	3	-3	9
5,13[illegible] feet	Avg. Max.	48.6	49.4	51.7	59.5	67.4	74.4	83.6	82.8	79.4	67.9	57.6	49.4	64.3	9
	Avg. Min.	22.7	24.2	26.3	31.6	36.7	41.7	47.7	46.1	43.3	36.5	29.3	25.5	34.3	9
Yosemite National Park	Highest	66	81	90	96	99	103	104	110	103	96	85	72	110	47
3,985 feet	Lowest	-6	1	9	12	15	22	33	31	24	19	10	-1	-6	47
	Avg. Max.	46.9	51.5	58.9	67.0	73.3	80.4	90.1	89.7	83.2	71.0	57.8	47.3	68.1	22
	Avg. Min.	25.5	27.7	31.2	37.0	42.5	47.3	53.5	52.1	47.1	39.2	30.8	27.6	38.5	22

TABLE 9

SUMMARY OF FREEZE-FREE PERIOD DATA IN THE MARIPOSA AREA

Station name, state number and elevation	Average last spring day with minimum temperature of			Average first fall day with minimum temperature of			Freeze-free period in days			32[1/]
	24°	28°	32°	32°	28°	24°	24°	28°	32°	
Auberry B7-0379 2,003 feet	2-3	3-16	4-20	11-10	11-27	12-11	324	305	207	21
Big Creek Powerhouse No. 1 B7-0755 4,930 feet	3-31	4-11	5-9	11-3	11-12	11-25	329	215	178	26
Cathay Bull Run Ranch B5-1588 1,425 feet	1-17	3-2	4-2	11-12	11-30	12-18	335	273	224	--
Denair B0-2389 124 feet	1-13	2-18	3-15	11-17	12-1	12-23	344	286	247	20
Dudleys B5-2539 3,000 feet	3-31	5-10	5-23	9-15	10-10	10-26	209	153	115	33
Friant Government Camp B7-3261 410 feet	1-24	3-3	3-23	11-27	12-16	12-24	337	289	246	34
Huntington Lake B7-4176 6,954 feet	5-9	5-28	6-4	9-28	10-20	11-11	186	145	116	19
Le Grand B0-4884 2,055 feet	1-21	2-5	3-14	11-18	12-4	12-19	326	306	249	16

(Continued)

TABLE 9 (Continued)

SUMMARY OF FREEZE-FREE PERIOD DATA IN THE MARIPOSA AREA

Station name, state number and elevation	Average last spring day with minimum temperature of			Average first fall day with minimum temperature of			Freeze-free period in days			32 [1/]
	24°	28°	32°	32°	28°	24°	24°	28°	32°	
Madera B0-5233 270 feet	1-28	2-15	3-10	11-15	11-27	12-15	321	287	250	24
Merced Fire Station No. 2 B0-5532 169 feet	1-28	2-12	3-13	11-13	12-7	12-20	326	298	246	4
North Fork Ranger Station B7-6252 2,630 feet	3-9	3-30	5-6	11-4	11-15	11-26	262	230	182	10
South Entrance Yosemite National Park B5-8380 5,120 feet	4-21	5-16	6-6	9-29	10-17	11-3	196	154	115	17
Yosemite National Park B5-9855 3,985 feet	3-17	4-16	5-7	10-18	11-6	12-2	260	204	164	18

1/ Standard deviation of number of days between recordings of 32° minimum temperature

TABLE 10

EVAPORATION RECORDS IN THE MARIPOSA AREA

Station		Location		Elevation, in feet	Average annual evaporation for period of record, in inches	Pan type	Source of record*	Period of record
Map number	Name	Latitude	Longitude					
B6-1612	Cedar Point Ranch - Nichols	37°28.4'	119°43.4'	3,350	----	Class A	DWR	1959 - 61
B4-2473	Don Pedro	37°43.0'	120°24.3'	604	77.6	Class A	USWB	1951 - 61
B4-2473	Don Pedro	36°43.0'	120°24.3'	604	59.9	Floating	TID	1924 - 61
B7-3261	Friant	36°59.0'	119°43.0'	410	88.9	Class A	USWB	1940 - 61
B0-3586	Greeley Hill-Schutt	37°43.0'	120°07.0'	3,130	----	Class A	DWR	1959 - 61
B0-4590	Knights Ferry 2SE	37°48.0'	120°38.7'	315	----	Class A	DWR	1959 - 61
B0-5233	Madera	36°58.0'	120°04.0'	270	73.4	Class A	USBR	1949 - 53
B6-7273	Raymond-Whipple Ranch	37°21.8'	120°53.5'	1,350	----	Class A	DWR	1959 - 61
B6-9728-01	Windy Gap	37°20.8'	119°45.3'	1,950	63.1	Class A	USBR	1951 - 54

*DWR Department of Water Resources
USWB U.S. Weather Bureau
TID Turlock Irrigation District
USBR U.S. Bureau of Reclamation

TABLE 11

RECORDS OF MONTHLY EVAPORATION IN THE MARIPOSA AREA

Number	Station	Year	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
B6-1612	Cedar Point Ranch - Nichols	1959		RB[a]	3.67	5.68	5.91	8.40	9.81	9.17	6.31	4.13	3.14	-	- [b]
		1960	-	-	-	-	-	8.88	10.08	Evap. record ends.					
B0-3586	Greeley Hill-Schutt	1959		RB[a]	2.69	4.50	5.21	6.95	10.12	-	3.98[c]	2.44	-	-	- [b]
		1960	-	-	-	-	-	7.86	8.96	8.86	5.81	2.95	Evap. record ends.		
B6-7273	Raymond-Whipple Ranch	1959	.54[c]	1.66	3.32	5.12	6.23	9.13	10.64	9.35	6.43	4.01	2.13	1.53	60.09
		1960	1.06	1.09	2.12	4.67[c]	6.35	9.53	11.68	10.44	8.33	4.64	1.82	1.02	62.75
		1961	1.43	1.87	2.98	4.31	5.96	9.62	11.13	10.32	7.91	5.65	2.45	.88	64.51
		1962	1.03	Evap. record ends.											
B6-9728-01	Windy Gap	1952											2.30	1.39	- [b]
		1953	1.50	1.92	3.11	4.58	5.53	7.10	11.69	9.58	7.43	4.44	2.11	.89	59.57
		1954	1.42	2.15	2.40	4.72	6.53	8.28	11.65	9.66	7.44	4.77	2.38[c]	1.07	66.53
		1955	1.00	1.79	3.03	3.98	4.84	-	M	12.70	9.01	5.45	-	-	- [b]

Windy Gap Station discontinued 10-31-55.

[a] Record beginning
[b] Incomplete annual record
[c] Partially estimated

TABLE 12

STREAM GAGING STATIONS IN AND ADJACENT TO THE MARIPOSA AREA

Plate 2 reference number	Stream	Station	Drainage area, in square miles	Period of record	Source of record*
1	Bear Creek Reservoir	Pool gage	72.0	1955-**	USACE
2	Bear Creek	Near Cathay	25.0	1957-**	DWR
3	Burns Creek	Below Burns Dam	74.0	1950-**	USACE
4	Burns Creek Reservoir	Pool gage	74.0	1949-**	USACE
5	Burns Creek	At Hornitos	26.7	1958-**	DWR
6	Chowchilla River	At Buchanan Damsite	238.0	1921-23 1930-**	USGS USGS
7	East Fork Chowchilla River	Near Ahwahnee	57.7	1957-**	DWR
8	Middle Fork Chowchilla River	Near Nipinnawasee	9.2	1957-**	DWR
9	West Fork Chowchilla River	Near Mariposa	33.6	1957-**	DWR
10	Striped Rock Creek	Near Raymond	7.8	1958-**	DWR
11	Miami Creek	Near Oakhurst	10.5	1959-**	DWR
12	Fresno River	Near Knowles	132.0	1911-13 1915-**	USGS USGS
13	Mariposa Creek	Below Mariposa Dam	108.0	1952-**	USACE
14	Mariposa Creek Reservoir	Pool gage	107.0	1948-**	USACE
15	Mariposa Creek	Near Cathay	74.0	1957-**	DWR
16	Maxwell Creek	Near Coulterville	12.9	1958-**	DWR

(Continued)

TABLE 12 (Continued)

STREAM GAGING STATIONS IN AND ADJACENT TO THE MARIPOSA AREA

Plate 2 reference number	Stream	Station	Drainage area, in square miles	Period of record	Source of record*
17	Merced River	At Exchequer	1,035.0	1901-13 1915-**	USGS USGS
18	Merced River	At Bagby	912.0	1922-**	USGS
19	Merced River	At Pohono Bridge	321.0	1916-**	USGS
20	South Fork Merced River	Near El Portal	239.0	1950-**	USGS
21	North Fork Merced River	Near Coulterville	30.3	1958-**	DWR
22	South Fork Tuolumne River	Near Oakland Recreation Camp	87.6	1923-**	USGS
23	Middle Fork Tuolumne River	At Oakland Recreation Camp	71.0	1916-**	USGS
24	Woods Creek	Near Jacksonville	98.4	1925-**	USGS

* USGS - United States Geological Survey
USACE - United States Army Corps of Engineers
DWR - Department of Water Resources

**Record continues to present time.

TABLE 13

RECORDED NATURAL RUNOFF
OF THE MERCED RIVER AT EXCHEQUER
(In acre-feet)

Runoff year :	Recorded natural runoff
1921-22	1,418,370
23	941,970
24	252,300
25	910,330
1925-26	609,840
27	1,083,560
28	736,300
29	489,600
30	521,100
1930-31	261,730
32	1,113,840
33	513,440
34	356,300
35	1,173,990
1935-36	1,151,190
37	1,209,790
38	2,077,700
39	473,420
40	1,092,300
1940-41	1,459,690
42	1,284,700
43	1,285,010
44	683,500
45	1,095,310
1945-56	940,140
47	562,620
48	691,100
49	637,700
50	718,700
1950-51	1,222,700
52	1,561,120
53	631,280
54	667,700
55	523,320
1955-56	1,671,170
Mean annual runoff	914,900

TABLE 14

AVERAGE MONTHLY DISTRIBUTION OF RUNOFF
OF THE MERCED RIVER AT EXCHEQUER

Month	Runoff, in acre-feet	Percent of annual runoff
October	5,840	0.6
November	19,950	2.2
December	47,620	5.2
January	48,830	5.3
February	80,680	8.8
March	92,150	10.1
April	148,900	16.3
May	245,400	26.8
June	166,200	18.2
July	45,100	4.9
August	10,050	1.1
September	4,130	0.5
Total	914,900	100.0

TABLE 15

ESTIMATED NATURAL RUNOFF OF THE SOUTH FORK MERCED RIVER BELOW BISHOP CREEK

Water year	Estimated runoff in acre-feet
1921-22	284,360
23	202,520
24	64,090
25	177,830
1925-26	111,930
27	207,840
28	139,210
29	96,920
30	92,700
1930-31	54,020
32	199,940
33	105,730
34	69,060
35	240,460
1935-36	213,740
37	243,050
38	499,800
39	112,680
40	234,170
1940-41	316,350
42	311,760
43	296,550
44	156,100
45	255,060
1945-46	224,290
47	121,760
48	131,710
49	123,980
50	137,940
1950-51	263,120
52	360,760
53	132,580
54	151,230
55	116,800
1955-56	340,920
Mean annual runoff	194,030

TABLE 16

ESTIMATED AVERAGE MONTHLY DISTRIBUTION OF RUNOFF,
SOUTH FORK MERCED RIVER BELOW BISHOP CREEK

Month	Runoff, in acre-feet	Percent of annual runoff
October	2,000	1.0
November	6,000	3.1
December	9,600	4.9
January	6,900	3.6
February	8,000	4.1
March	13,500	7.0
April	30,600	15.8
May	58,500	30.2
June	44,800	23.0
July	12,700	6.6
August	1,000	0.5
September	400	0.2
Mean annual runoff	194,000	100.0

TABLE 17

RECORDS OF RUNOFF ON TRIBUTARIES OF THE UPPER CHOWCHILLA RIVER
(In acre-feet)

Runoff season	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	TOTAL
East Fork Chowchilla River near Ahwahnee													
1957-58	NR	Inc.	697	1,357	5,476	11,670	17,300	4,124	1,357	430	134	93	(42,638)*
-59	92	170	209	708	3,371	1,200	661	405	71	2	0	95	6,984
-60	53	116	151	423	2,672	1,573	1,370	842	120	4	0	0	7,324
-61	10	395	564	310	564	738	447	264	53	0	0	0	3,345
-62	0	73	382	295	12,900	6,710	2,249	905	283	43	2	0	23,840
-63	96	106	187	4,103	7,192	3,784	8,011	4,141	1,365	453	98	63	29,600
Middle Fork Chowchilla River near Nipinnawasee													
1957-58	NR	NR	NR	NR	NR	Inc.	6,631	1,059	280	61	5	0	- - -
-59	2	22	37	117	1,364	205	156	69	.1	0	0	19	1,992
-60	0	2	12	54	975	543	343	113	3	0	0	0	2,045
-61	0	51	138	36	105	215	75	36	3	0	0	0	659
-62	0	0	39	41	4,318	1,401	395	202	53	1	0	0	6,450
-63	12	12	26	1,421	1,722	996	2,801	1,109	317	57	8	12	8,492
West Fork Chowchilla River near Mariposa													
1957-58	NR	Inc.	219	1,131	3,195	7,890	11,200	1,346	353	53	2	0	(25.389)*
-59	1	32	42	197	2,305	257	297	119	10	0	0	68	3.328
-60	0	5	29	142	1,759	898	506	217	12	0	0	0	3.568
-61	0	12	69	68	95	212	103	42	5	0	0	0	606
-62	0	0	26	89	7,642	3,675	669	294	59	1	0	0	12.460
-63	0	3	35	3,259	3,352	1,375	5,314	1,884	472	82	4	0	15.780

(Continued)

TABLE 17 (Continued)

RECORDS OF RUNOFF ON TRIBUTARIES OF THE UPPER CHOWCHILLA RIVER
(In acre-feet)

Runoff season	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	TOTAL
Striped Rock Creek near Raymond													
1957-58	NR	Inc.	45	388	1,178	3,154	4,840	487	96	15	3	4	(10.210)*
-59	6	14	22	36	489	90	60	15	1	0	0	7	740
-60	6	6	7	18	815	148	114	17	0	0	0	0	1,131
-61	0	25	13	19	55	86	21	5	0	0	0	0	224
-62	0.0	0.0	12	36	3,792	1,090	279	74	9	0.0	0.0	0.0	5,293
-63	12	9	15	731	1,292	493	1,662	507	112	5	1	1	4,841

* Incomplete record

TABLE 18

RECORDS OF RUNOFF ON STREAMS OF THE EASTERN MERCED COUNTY STREAM GROUP
(In acre-feet)

Runoff season	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	TOTAL
Mariposa Creek near Cathay													
1957-58	NR	Inc.	790	2,611	6,218	16,010	19,970	1,271	285	40	0	0	(47.195)*
-59	0	46	108	562	3,643	445	295	108	4	0	0	175	5,386
-60	11	32	84	467	4,050	1,068	757	159	3	0	0	0	6,631
-61	0	104	488	188	277	344	117	56	3	0	0	0	1,577
-62	0	0	140	423	17,910	5,429	586	206	33	0	0	0	24.720
-63	0	0	281	5,912	8,436	3,012	8,799	1,759	344	46	0	0	28,590
Bear Creek near Cathay													
1957-58	NR	NR	Inc.	2,117	3,636	8,052	6,809	111	12	0	0	0	(20,737)*
-59	0	0	0	261	2,602	137	44	15	0	0	0	148	3,207
-60	0	0	0	357	3,427	904	380	61	0	0	0	0	5,129
-61	0	53	567	50	185	106	27	0	0	0	0	0	988
-62	0	0	43	143	8,716	2,216	114	23	0	0	0	0	11,255
-63	0	0	97	2,132	4,777	2,225	4,538	473	38	11	0	0	14,290
Burns Creek at Hornitos													
1958-59	NR	NR	NR	177	666	63	30	9	0	0	0	0	(945)*
-60	0	0	0	63	1,329	158	111	17	0	0	0	0	1,678
-61	0	0	0	2	41	56	11	1	0	0	0	0	111
-62	0	0	4	16	5,897	1,127	77	22	8	0	0	0	7,151
-63	0	0	14	206	1,777	747	1,422	374	11	0	0	0	4,551

* Incomplete record

TABLE 19

RECORDS OF RUNOFF ON THE NORTH SIDE OF THE MERCED RIVER BASIN
(In acre-feet)

Runoff season	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	TOTAL
North Fork Merced River near Coulterville													
1958-59	NR	NR	Inc.	293	2,003	308	180	105	29	18	14	62	(- - -)*
-60	36	69	88	168	2,249	545	455	204	34	17	16	20	3.901
-61	20	69	173	73	101	196	100	78	28	8	3	12	861
-62	9	19	215	157	6,300	2,299	416	170	72	25	15	15	9,712
-63	61	51	76	3,746	3,363	1,449	3,753	1,406	362	114	64	58	14,500
Maxwell Creek at Coulterville													
1958-59	--	--	--	199	760	63	36	19	4	0	0	66	(- - -)*
-60	9	6	16	180	1,834	384	294	93	3	0	0	0	2,819
-61	0	4	42	18	65	108	29	26	26	0	0	0	318
-62	0.0	2	34	37	3,253	1,102	132	34	12	0.0	0.0	0.0	4,605
-63	2	1	23	773	1,101	973	2,027	481	78	8	0	0	5,466

* Incomplete record

TABLE 20

ANALYSES OF SURFACE WATER IN THE MARIPOSA AREA[a]

Source	Location number	Date sampled	Discharge in cfs	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
Maxwell Creek	2S/16E-34K	6/10/58	0.2[b]	71	256	7.2	25 / 1.25	13 / 1.07	8.0 / 0.35	0.9 / 0.02	0 / 0.00	139 / 2.28	12 / 0.25	4.4 / 0.12	0 / 0.00	0.8 / 0.01	0	28		160	13	115	1	
		9/18/58		69	382	8.2	38 / 1.90	22 / 1.80	11 / 0.48	0.7 / 0.02	0 / 0.00	227 / 3.72	12 / 0.25	6.0 / 0.17	0.2 / 0.01	0.4 / 0.01	0.07	32		234	11	185	0	
		1/21/59	--	42	282	7.9	27 / 1.35	16 / 1.32	9.0 / 0.39	0.8 / 0.02	0 / 0.00	146 / 2.39	21 / 0.44	7.5 / 0.21	0.1 / 0.01	0.6 / 0.01	0.0	26		180	13	132	12	Gage height 2.75 (c)
		5/19/59	--	56	314	7.9	32 / 1.60	16 / 1.32	8.8 / 0.38	0.6 / 0.02	0 / 0.00	176 / 2.88	13 / 0.27	4.9 / 0.14	0.1 / 0.01	0.4 / 0.01	0.04	27		189	11	147	3	Gage height 2.62
		1/26/60	--	50	168	7.7	16 / 0.80	7.3 / 0.60	5.1 / 0.22	0.6 / 0.02	0 / 0.00	78 / 1.28	11 / 0.23	2.4 / 0.07	0.2 / 0.01	1.8 / 0.03	0.05	20		102	13	70	6	Gage height 3.10
Bean Creek	2S/17E-20M	1/26/60	0.5[b]	44	62.6	6.8	5.9 / 0.29	0.8 / 0.07	2.7 / 0.12	2.0 / 0.05	0 / 0.00	21 / 0.34	3.6 / 0.07	1.8 / 0.05	0.0 / 0.00	1.8 / 0.03	0.06	1.1		40	23	18	1	
		1/26/60																	Fe 0.31; Al 0.71; Cr 0.03; (d)					(c)
Merced River	4S/17E-6K	6/10/58	--	57	18.8	6.3	1.7 / 0.08	0.5 / 0.04	0.9 / 0.04	0.7 / 0.02	0 / 0.00	10 / 0.16	0 / 0.00	0.5 / 0.01	0 / 0.00	0.8 / 0.01	0	6.0		16	22	6	0	
		9/18/58	--	69	69	7.2	7.8 / 0.39	0.8 / 0.07	2.8 / 0.12	1.0 / 0.03	0 / 0.00	29 / 0.48	1.8 / 0.04	2.1 / 0.06	0.0 / 0.00	0.4 / 0.01	0.00	11		42	20	23	0	
		1/21/59	--	43	70.7	7.2	9.6 / 0.48	0.5 / 0.04	3.3 / 0.14	1.0 / 0.03	0 / 0.00	30 / 0.49	4.8 / 0.10	4.0 / 0.11	0.0 / 0.00	0.4 / 0.01	0.0	13		52	20	26	1	Gage height 1.5 (c)
		5/19/59	1200[b]	52	23.0	6.7	2.4 / 0.12	0.0 / 0.00	1.6 / 0.07	0.1 / 0.00	0 / 0.00	9 / 0.15	0.8 / 0.02	0.0 / 0.00	0.0 / 0.00	0.4 / 0.01	0.04	6.4		16	37	6	0	
		9/15/59	--	68	119	7.2	15 / 0.75	0.8 / 0.07	5.4 / 0.23	1.7 / 0.04	0 / 0.00	53 / 0.87	3.6 / 0.07	6.2 / 0.17	0.1 / 0.01	0.1 / 0.00	0.03	9.9		69	21	41	0	Gage height 0.8
		1/26/60	--	48	103	7.2	12 / 0.60	1.7 / 0.14	3.6 / 0.16	1.6 / 0.04	0 / 0.00	39 / 0.64	10 / 0.21	2.0 / 0.06	0.0 / 0.00	2.2 / 0.04	0.11	14		66	17	37	5	Gage height 2.28
Whitlock Creek	4S/18E-31A	9/16/59	0.1[b]	68	384	8.2	40 / 2.00	22 / 1.78	9 / 0.39	0.6 / 0.02	0 / 0.00	236 / 3.87	5.1 / 0.11	7.8 / 0.22	0.2 / 0.01	0.6 / 0.01	0.00	27	Cu 0.01; (d)	228	9	189	0	

(Continued)

TABLE 20 (Continued)

ANALYSES OF SURFACE WATER IN THE MARIPOSA AREA[a]

Source	Location number	Date sampled	Discharge in cfs	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Hardness as $CaCO_3$: Percent sodium	Total ppm	Non-carbonate ppm	Remarks
Plumber Creek	4S/19E-30R	1/28/60	0.2[b]	41	101	7.2	8.5 / 0.42	2.7 / 0.22	4.4 / 0.19	1.5 / 0.04	0 / 0.00	29 / 0.48	15 / 0.31	1.9 / 0.05	0.1 / 0.01	0.4 / 0.01	0.02	17		66	22	32	8	
	-31A	1/21/59	0.01[b]	48	88.2	7.0	7.2 / 0.36	3.4 / 0.28	4.6 / 0.20	1.0 / 0.03	0 / 0.00	28 / 0.46	16 / 0.33	3.0 / 0.08	0.0 / 0.00	0.2 / 0.00	0.0	20		69	23	32	9	
		5/19/59	0.2[b]	70	101	7.2	9.4 / 0.47	2.8 / 0.23	4.2 / 0.18	1.3 / 0.03	0 / 0.00	47 / 0.77	3.8 / 0.08	1.1 / 0.03	0.1 / 0.01	0.5 / 0.01	0.02	12		58	20	35	0	(c)
Burns Creek	5S/16E-17G	6/10/58	0.5[b]	64	370	7.6	30 / 1.50	20 / 1.68	15 / 0.65	3.2 / 0.08	0 / 0.00	176 / 2.88	36 / 0.75	8.9 / 0.25	0.2 / 0.01	2.6 / 0.04	0	30		232	17	159	15	
		1/21/59	0.5[b]	55	409	8.2	34 / 1.70	23 / 1.90	18 / 0.78	0.9 / 0.02	0 / 0.00	172 / 2.82	56 / 1.17	14 / 0.39	0.2 / 0.01	4.3 / 0.07	0.0	26		261	18	180	39	(c)
		2/4/59	1.0[b]	44	--	--													Fe 0.03					(c)
		5/19/59	0.5[b]	72	413	8.1	32 / 1.60	23 / 1.90	20 / 0.87	1.2 / 0.03	0 / 0.00	188 / 3.08	42 / 0.87	12 / 0.34	0.2 / 0.01	1.4 / 0.02	0.08	27	As 0.00	251	20	175	21	
	-17K	1/26/60	--	54	272	7.7	22 / 1.10	13 / 1.07	9.6 / 0.42	1.5 / 0.04	0 / 0.00	101 / 1.66	35 / 0.73	6.7 / 0.19	0.2 / 0.01	4.2 / 0.07	0.08	18		160	16	110	27	Gage height 2.87
Bear Creek	5S/17E-21P	6/10/58	--	64	261	6.9	23 / 1.15	14 / 1.15	8.8 / 0.38	1.0 / 0.02	0 / 0.00	127 / 2.08	18 / 0.37	5.7 / 0.16	0.1 / 0.01	0.4 / 0.01	0	32		165	14	114	10	Gage height 3.3
		1/21/59	--	50	280	7.8	25 / 1.25	14 / 1.15	9.0 / 0.39	0.5 / 0.01	0 / 0.00	120 / 1.97	23 / 0.48	10 / 0.28	0.1 / 0.01	5.4 / 0.09	0.0	25		171	14	120	22	Gage height 3.34 (c)
		5/19/59	--	70	287	8.1	26 / 1.30	16 / 1.32	10 / 0.44	1.0 / 0.02	0 / 0.00	149 / 2.44	18 / 0.37	6.6 / 0.19	0.1 / 0.01	0.4 / 0.01	0.06	32		183	14	130	8	Gage height 2.96
		1/26/60	--	52	136	7.6	12 / 0.60	5.8 / 0.48	3.9 / 0.17	0.6 / 0.02	0 / 0.00	58 / 0.95	8.7 / 0.18	2.4 / 0.07	0.1 / 0.01	1.6 / 0.02	0.10	16		79	13	54	6	Gage height 4.18
Stockton Creek	5S/18E-12F	6/12/58	--	60	273	8.3	28 / 1.40	14 / 1.15	3.1 / 0.13	1.6 / 0.04	4 / 0.13	155 / 2.54	0.3 / 0.01	3.3 / 0.09	0.2 / 0.01	0.1 / 0.00	0.0	23		154	5	130	0	
		9/18/58	0.1[b]	59	357	8.1	38 / 1.90	18 / 1.48	11 / 0.48	1.6 / 0.04	0 / 0.00	201 / 3.29	19 / 0.40	3.8 / 0.11	0.2 / 0.01	0.7 / 0.01	0.38	29		221	12	168	3	
		1/21/59	--	40	319	7.9	33 / 1.65	18 / 1.48	8.8 / 0.38	1.8 / 0.05	0 / 0.00	180 / 2.95	24 / 0.50	5.5 / 0.16	0.1 / 0.01	1.0 / 0.02	0.0	26		207	11	158	10	(c)

(Continued)

TABLE 20 (Continued)

ANALYSES OF SURFACE WATER IN THE MARIPOSA AREA[a]

Source	Location number	Date sampled	Discharge in cfs	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Percent sodium	Hardness as CaCO3 Total ppm	Hardness as CaCO3 N.C. ppm	Remarks
Stockton Creek (continued)	5S/18E-12F	5/19/59	0.4[b]	58	318	8.1	36 / 1.80	14 / 1.15	9.3 / 0.40	1.0 / 0.02	0 / 0.00	171 / 2.80	19 / 0.40	4.6 / 0.13	0.2 / 0.01	0.5 / 0.01	0.05	24		193	12	150	10	
		1/28/60	0.5[b]	42	260	8.0	28 / 1.40	12 / 1.00	6.8 / 0.30	1.1 / 0.03	0 / 0.00	134 / 2.20	18 / 0.37	3.2 / 0.09	0.1 / 0.01	0.3 / 0.00	0.02	19		154	11	120	10	
Mariposa District Reservoir	-14	1/22/59	--	50	207	7.5	22 / 1.10	9.2 / 0.76	5.4 / 0.23	1.2 / 0.03	0 / 0.00	112 / 1.84	9.6 / 0.20	4.0 / 0.11	0.0 / 0.00	1.2 / 0.02	0.0	10		118	11	93	1	(c)
Stockton Reservoir	-14A	9/16/59	--	--	223	7.3	23 / 1.15	10 / 0.87	6.6 / 0.29	1.2 / 0.03	0 / 0.00	123 / 2.02	7.4 / 0.15	3.2 / 0.09	0.1 / 0.01	0.8 / 0.01	0.01	12	Fe 0.00; Mn 0.00	124	12	101	0	
		1/28/60	--	52	219	7.6	23 / 1.15	9.8 / 0.81	5.7 / 0.25	1.4 / 0.04	0 / 0.00	114 / 1.87	19 / 0.40	2.8 / 0.08	0.0 / 0.00	1.8 / 0.03	0.04	15		134	11	98	5	
Peg Leg Creek	5S/19E-28R	1/27/60	0.3[b]	42	126	7.4	13 / 0.65	2.8 / 0.23	5.9 / 0.26	1.6 / 0.04	0 / 0.00	63 / 1.03	2.5 / 0.05	2.4 / 0.07	0.1 / 0.01	1.2 / 0.02	0.10	24		85	22	44	0	
		1/27/60																	Fe 0.16; Al 0.46; Cr 0.01; (d)					(c)
S. F. Merced River	5S/21E-3	6/12/58	--	46	12.5	6.8	1.6 / 0.08	0.0 / 0.00	1.5 / 0.06	0.5 / 0.01	0 / 0.00	8 / 0.13	0.8 / 0.02	0.0 / 0.00	0.0 / 0.00	0.1 / 0.00	0	5.6		14	40	4	0	
		9/17/58	3[b]	66	40	6.9	3.1 / 0.15	0.1 / 0.01	2.9 / 0.13	0.8 / 0.02	0 / 0.00	15 / 0.24	0.8 / 0.02	1.6 / 0.04	0.0 / 0.00	0.6 / 0.01	0.16	12		29	42	8	0	
		1/20/59	16[b]	38	34.0	7.1	3.2 / 0.16	0.2 / 0.02	3.0 / 0.13	0.3 / 0.01	0 / 0.00	14 / 0.23	1.0 / 0.02	3.0 / 0.08	0.0 / 0.00	0.2 / 0.00	0.0	13		31	41	9	0	(c)
		5/20/59	300[b]	49	13.0	6.7	1.7 / 0.08	0.0 / 0.00	0.9 / 0.04	0.0 / 0.00	0 / 0.00	5 / 0.08	0.6 / 0.01	0.3 / 0.01	0.0 / 0.00	0.5 / 0.01	0.06	6.1		12	33	4	0	
		9/17/59	8[b]	58	53.0	6.8	3.6 / 0.18	0.2 / 0.02	4.4 / 0.19	1.0 / 0.02	0 / 0.00	19 / 0.31	1.2 / 0.02	3.0 / 0.08	0.0 / 0.00	0.5 / 0.01	0.03	14		37	46	10	0	
Owens Creek	6S/17E-15D	6/10/58	--	65	393	7.0	38 / 1.90	19 / 1.58	16 / 0.70	1.0 / 0.02	0 / 0.00	232 / 3.80	3.4 / 0.07	12 / 0.34	0.1 / 0.01	1.2 / 0.02	0	50		255	17	174	0	
		9/19/58	0	68	476	8.2	35 / 1.75	28 / 2.33	24 / 1.04	1.3 / 0.03	0 / 0.00	271 / 4.44	1.3 / 0.03	22 / 0.62	0.2 / 0.01	0.1 / 0.00	0.01	62		307	20	204	0	
		1/21/59	0.01[b]	52	449	8.0	45 / 2.25	22 / 1.83	20 / 0.87	0.9 / 0.02	0 / 0.00	256 / 4.20	11 / 0.23	17 / 0.48	0.2 / 0.01	1.6 / 0.03	0.0	51		295	18	204	0	(c)

(Continued)

TABLE 20 (Continued)

ANALYSES OF SURFACE WATER IN THE MARIPOSA AREA[a]

Source	Location number	Date sampled	Discharge in cfs	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
Owens Creek (continued)	6S/17E-15D	5/18/59	0.25[b]	64	514	8.1	50 / 2.50	26 / 2.14	22 / 0.96	1.8 / 0.05	0 / 0.00	305 / 5.00	2.8 / 0.06	16 / 0.45	0.3 / 0.02	0.8 / 0.01	0.29	54		324	17	232	0	
		1/28/60	0.3[b]	50	522	8.0	51 / 2.54	26 / 2.12	23 / 1.00	1.2 / 0.03	0 / 0.00	288 / 4.72	19 / 0.40	19 / 0.54	0.2 / 0.01	0.5 / 0.01	0.02	48		330	18	233	0	
Agua Fria Creek	6S/18E-4D	1/27/60	3[b]	52	200	7.8	25 / 1.75	6.0 / 0.49	6.5 / 0.28	1.0 / 0.02	0 / 0.00	97 / 1.59	16 / 0.33	2.9 / 0.08	0.1 / 0.01	0.4 / 0.01	0.03	20		126	14	87	7	
		1/27/60																	Al 0.18; Cr 0.01; (d)					(c)
Mariposa Creek	-21G	6/11/58	--	74	259	7.8	22 / 1.10	15 / 1.24	7.5 / 0.33	1.8 / 0.05	0 / 0.00	148 / 2.42	7.6 / 0.16	4.6 / 0.13	0.0 / 0.00	0.0 / 0.00	0.0	30		162	12	117	0	Gage height 1.6
		9/18/58	--	78	396	8.2	34 / 1.70	22 / 1.82	17 / 0.74	2.3 / 0.06	0 / 0.00	230 / 3.77	2.8 / 0.06	17 / 0.48	0.2 / 0.01	1.2 / 0.02	0.02	33		242	17	176	0	Gage height 1.7
		1/22/59	--	45	313	8.1	27 / 1.35	18 / 1.48	11 / 0.48	1.0 / 0.03	0 / 0.00	162 / 2.66	19 / 0.40	10 / 0.28	0.0 / 0.00	0.0 / 0.00	0.0	22		188	14	142	9	Gage height 2.77 (c)
		5/18/59	--	67	325	8.2	27 / 1.35	18 / 1.48	13 / 0.56	1.7 / 0.04	0 / 0.00	181 / 2.97	9.0 / 0.19	6.8 / 0.19	0.2 / 0.01	0.3 / 0.00	0.28	28		193	16	141	0	Gage height 2.56
		1/27/60	--	50	218	8.0	19 / 0.95	12 / 0.99	6.8 / 0.30	1.3 / 0.03	0 / 0.00	115 / 1.88	11 / 0.23	4.2 / 0.12	0.1 / 0.01	0.4 / 0.01	0.03	19		130	13	97	3	Gage height 3.22
W. F. Chowchilla River	6S/19E-10Q	6/11/58	--	64	154	7.3	15 / 0.75	4.5 / 0.37	9.1 / 0.40	1.5 / 0.04	0 / 0.00	86 / 1.41	0 / 0.00	5.0 / 0.14	0 / 0.00	0.9 / 0.01	0	40		118	26	56	0	Gage height 3.0
		9/18/58	--	78	270	8.0	26 / 1.30	7.8 / 0.64	18 / 0.78	1.7 / 0.04	0 / 0.00	146 / 2.39	1.5 / 0.03	10 / 0.28	0.2 / 0.01	0.7 / 0.01	0.08	38		176	28	97	0	Gage height 3.1
		1/22/59	--	43	207	7.7	20 / 1.00	5.8 / 0.48	12 / 0.52	1.4 / 0.04	0 / 0.00	92 / 1.51	7.7 / 0.16	15 / 0.42	0.1 / 0.01	0.0 / 0.00	0.0	30		137	25	74	0	Gage height 2.6 (c)
		5/18/59	--	80	216	8.0	21 / 1.05	6.2 / 0.51	12 / 0.52	1.8 / 0.05	0 / 0.00	110 / 1.80	1.2 / 0.02	9.4 / 0.26	0.2 / 0.01	0.3 / 0.00	0.31	34		140	24	78	0	Gage height 2.50
		1/27/60	--	45	149	7.5	15 / 0.75	3.3 / 0.27	8.0 / 0.35	1.6 / 0.04	0 / 0.00	67 / 1.10	4.9 / 0.10	6.7 / 0.19	0.1 / 0.01	1.0 / 0.02	0.04	24		98	25	51	0	Gage height 2.85

(Continued)

TABLE 20 (Continued)

ANALYSES OF SURFACE WATER IN THE MARIPOSA AREA[a]

Source	Location number	Date sampled	Discharge in cfs	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
M. F. Chowchilla River	6S/19E-25J	1/27/60	--	46	126	7.6	11 0.55	2.3 0.19	9.4 0.41	1.5 0.04	0 0.00	64 1.05	0.3 0.01	2.8 0.08	0.3 0.02	0.4 0.01	0.03	28		87	34	37	0	Gage height 2.84
Striped Rock Creek	7S/19E-15G	1/27/60	0.3(b)	56	337	8.3	33 1.65	10 0.83	22 0.96	3.1 0.08	2 0.07	165 2.70	11 0.23	19 0.54	0.2 0.01	0.1 0.00	0.02	30		211	27	124	0	
		1/27/60																	Al 0.21; (d)					(c)
E. F. Chowchilla River	7S/20E-7J	6/11/58	--	64	112	6.6	10 0.50	1.4 0.12	9.1 0.40	1.5 0.04	0 0.00	52 0.85	0 0.00	7.7 0.22	0 0.00	0.8 0.01	0	31		86	38	31	0	
		9/18/58	--	79	261	7.8	22 1.10	5.1 0.42	20 0.87	2.6 0.07	0 0.00	97 1.59	2.1 0.04	28 0.79	0.1 0.01	0.4 0.01	0.19	35		163	35	76	0	Gege height 3.57
		1/22/59	--	44	218	7.5	18 0.90	3.6 0.30	19 0.83	1.7 0.04	0 0.00	68 1.11	5.8 0.12	30 0.85	0.0 0.00	0.0 0.00	0.0	29		140	40	60	4	Gege height 3.70 (c)
		5/18/59	--	79	180	7.7	15 0.75	2.6 0.21	16 0.70	1.9 0.05	0 0.00	67 1.10	2.6 0.05	19 0.54	0.1 0.01	0.4 0.01	0.06	30		121	41	48	0	Gege height 3.6
		9/14/59	0.05(b)	72	359	7.9	31 1.55	4.2 0.35	34 1.48	3.2 0.08	0 0.00	120 1.97	6.7 0.14	45 1.27	0.2 0.01	0.5 0.01	0.03	37		221	43	95	0	
		1/27/60	--	48	145	7.2	12 0.60	1.4 0.12	11 0.48	1.6 0.04	0 0.00	44 0.72	2.1 0.04	16 0.45	0.2 0.01	0.7 0.01	0.06	23		90	39	36	0	Gage height 3.78

(e) Analyses by Department of Water Resources, Bryte Laboratory, unless otherwise noted in remarks column.

(b) Estimated

(c) Analysis by United Stetes Geological Survey Laboratory.

(d) Iron (Fe), Aluminum (Al), Manganese (Mn), Copper (Cu), Lead (Pb), Zinc (Zn), Arsenic (As), Chromium (Cr), heve bean analyzed and values ere 0.00 except as shown.

TABLE 21

ANALYSES OF GROUND WATER IN THE MARIPOSA AREA[a]

Owner and use	Well number	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm	Percent Sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
F. E. Cummings Domestic	4S/17E-20	9/15/59	64	590	7.9	92 4.59	11 0.88	22 0.96	1.7 0.04	0 0.00	304 4.98	54 1.12	17 0.48	0.2 0.01	0.4 0.01	0.03	27		374	15	274	25	Depth 60'
W. D. McLean None	-25	1/13/54	--	397	7.8	50 2.50	19 1.56	7.2 0.31	0.3 0.01	0 0.00	240 3.93	8.5 0.18	6.0 0.17	0.0 0.00	1.5 0.02	0.02	39		250	7	203	6	Spring(b)
L. Ericksen Domestic	5S/16E-13K	9/15/59	--	426	7.4	38 1.90	23 1.86	16 0.70	2.0 0.05	0 0.00	194 3.18	44 0.92	9.5 0.27	0.2 0.01	6.9 0.11	0.05	56		291	16	188	29	Depth 30'
C. Orliz Domestic	-17J	9/15/59	75	846	7.5	74 3.69	24 1.98	63 2.74	5.4 0.14	0 0.00	204 3.34	164 3.41	65 1.83	0.5 0.03	0.9 0.01	0.08	32	Fe 0.05; Mn 0.08; Cu 0.02; Pb 0.01; Zn 0.05;(c)	529	32	284	117	Depth 66'
L. Tashjain Domestic	5S/18E-7	9/15/59	64	685	7.5	98 4.89	23 1.88	18 0.78	0.5 0.01	0 0.00	291 4.77	119 2.48	12 0.34	0.2 0.01	0.4 0.01	0.02	28	Fe 0.00; Mn 0.00	442	10	339	100	Depth 55'
Bootjack Store Domestic	5S/19E-27M	9/14/59	--	299	7.0	32 1.60	8.3 0.68	16 0.70	1.8 0.05	0 0.00	137 2.24	1.0 0.02	6.8 0.19	0.1 0.01	32 0.52	0.02	50		215	23	114	2	Depth 66'
R. L. Ball Domestic	5S/20E-7K	5/16/59	70	122	7.0	13 0.65	2.3 0.19	6.7 0.29	1.2 0.03	0 0.00	58 0.95	0.5 0.01	3.0 0.08	0.2 0.01	5.5 0.09	0.04	47		107	25	42	0	Depth 24'
H. Avery Domestic	6S/17E-3	9/15/59	--	396	7.4	39 1.95	18 1.45	15 0.65	2.2 0.06	0 0.00	194 3.18	12 0.25	14 0.39	0.1 0.01	18 0.29	0.01	67		280	16	170	11	Depth 25'
Stonehouse Domestic	-14M	9/15/59	--	330	7.4	35 1.75	12 0.97	15 0.65	1.1 0.03	0 0.00	164 2.69	9.7 0.20	9.6 0.27	0.2 0.01	10 0.16	0.03	68		242	19	136	2	Depth 32'
C. L. Robertson Domestic	6S/18E-12F	9/14/59	72	229	7.1	20 1.00	6.1 0.50	16 0.70	4.5 0.12	0 0.00	127 2.08	0.6 0.01	5.8 0.16	0.2 0.01	3.2 0.05	0.03	57	Fe 0.06; Mn 0.00	175	30	75	0	Depth 18'
Specimen Spring	7S/19E-23M	5/14/59	75	956	7.8	70 3.49	5.5 0.45	109 4.74	3.5 0.09	0 0.00	156 2.56	6.4 0.13	216 6.09	0.3 0.02	1.6 0.02	0.19	37	Cu 0.01; Pb 0.01 (c)	526	54	197	69	Spring

(a) Analyses by Department of Water Resources, Bryte Laboratory, unless otherwise noted in remarks column.

(b) Analysis by United States Geological Survey Laboratory.

(c) Iron (Fe), Aluminum (Al), Manganese (Mn), Copper (Cu), Lead (Pb), Zinc (Zn), Arsenic (As), Chromium (Cr), have been analyzed and values are 0.00 except as shown.

CHAPTER III. LAND USE AND WATER REQUIREMENTS

During the Mariposa Area Investigation the water requirements of Mariposa County were determined. They are expressed in this chapter in terms of urban, residential-farm, and irrigation needs. Water requirements are considered to be the amounts of water needed to provide for all beneficial uses and for all irrecoverable losses incidental to such uses.

This chapter describes land classification and land use surveys. The results of these surveys were used to determine water requirements. The service areas are shown on Plate 4, "Plans for Development".

Land Classification

The lands of Mariposa County were classified into five groups. These groups were as follows: irrigable, urban, recreation, irrigable forest and range, and unsegregated nonirrigable lands. The specifications and conditions that define the various classes are shown in Appendix A of this report.

Irrigable Lands

Soil characteristics and the physiography of the landscape were the factors considered in classification of irrigable lands. Indirect items such as those economic factors related to the production and marketing of crops, the location of the land with respect to a water supply, and climatic conditions were not considered.

All lands considered to be irrigable were divided into three broad topographic groups. These three groups were defined as being smooth-lying valley lands, gently sloping and undulating lands, and steeper and

more rolling lands. Representative slopes throughout the area were measured with a clinometer to determine their degree of slope. The three broad topographic classes indicated by symbols V, H, and M, smooth, gently sloping, and steeply sloping, respectively, were further subdivided in accordance with the nature of any limiting condition. These limiting conditions included the following subclassifications: high water table, indicated by w; heavy soil texture, indicated by h; shallow soil depth, indicated by p; and excessive rockiness, indicated by r. The characteristics of the soils were established by examination of road cuts, ditch banks, material from test holes, together with observations of the native vegetation and crops.

Irrigable lands of Mariposa County are indicated on Plate 3, "Classification of Lands and 1959 Land Use", by the symbol "A".

Urban Lands

A land classification survey should insofar as possible provide an unchanging inventory of physical conditions. Future urban expansion within Mariposa County will undoubtedly encroach upon irrigable lands; however, the location and time of such growth are uncertainties. For these reasons, the classification of urban lands was restricted to a delineation of present urban areas. The areas of towns and communities presently used for residential, commercial, recreational, and industrial purposes were indicated on Plate 3 by the symbol UD. In Table 22, "Classification of Lands of Mariposa County", it is shown that 320 acres in Mariposa County have been classified as urban.

Recreation Lands

The potential recreation lands of Mariposa County were divided

TABLE 22

CLASSIFICATION OF LANDS OF MARIPOSA COUNTY[1/]
(In acres)

Land class	Acres	Land class	Acres
V (Smooth)	2,030	F (Forest)	12,710
Vw	150	UD (Urban)	320
Vh	410	RR (Recreation)	19,160
Vp	800	RC	140
Vpr	20	RT	350
H (Gently sloping)	13,980	PP (Park)	244,140
Hp	29,950	N (Native)	513,540
Hr	1,560		
Hpr	10,450		
M (Steeply sloping)	3,280		
Mp	52,940		
Mr	410		
Mpr	32,010		
Total Agricultural	147,990	Total County Area	938,350

1/ A description of characteristics of lands as indicated by these symbols is contained in Appendix A of this report.

into four classes: permanent and summer home tracts, indicated by the symbol RR; commercial areas, indicated by the symbol RC; camp and trailer sites, indicated by the symbol RT; and existing federal parks (Yosemite National Park), indicated by the symbol PP. The lands adjudged to be potential home areas were further subdivided according to the probable density of development on these lands. The locations of these various types of anticipated developments were estimated from observations of presently developed areas. Potential recreation lands are indicated on Plate 3 by the symbol S. The estimated acreages of each class are shown in Table 22.

In view of the ever-increasing population in California, it is evident that there will be a demand for considerable areas for recreation purposes. This is particularly true of the mountainous regions where this type of development is expanding rather rapidly at the present time. The California Public Outdoor Recreation Plan, Part I, shows that the Mariposa area is so situated as to be adaptable to week-end type usage from both the Los Angeles and San Francisco metropolitan areas.

Obviously, much of the mountainous land is suitable for some recreation use such as hunting, fishing, and other outdoor activities. For the purpose of the investigation, however, consideration was given only to those lands where some fairly intensive development might occur which would require water service. These are indicated on Plate 3, by the symbol S.

Irrigable Forest and Range Lands

Irrigable forest and range lands were classified in the same manner as the other irrigable lands, in accordance with their appropriate crop adaptability class, and further subdivided into timber producing

and range lands. The economy of Mariposa County is greatly influenced by the production of livestock, and it appears reasonable that such classes would remain as grazing lands. These irrigable forest and range lands were indicated on Plate 3 by the symbol F. Table 22 indicates that there are 12,710 acres of these lands in Mariposa County.

Major Park Lands

Mariposa County contains 244,140 acres of land within Yosemite National Park. This is indicated in Table 22 by the symbol PP.

Native Vegetation Lands

All lands not included in the above classifications were indicated on Plate 3 by the symbol N. These lands are considered to remain in a native condition which would not require supplemental water supplies. Table 22 indicates 513,540 acres of these N lands in Mariposa County.

Summary

The results of the land classification survey of Mariposa County are shown in Table 22. About 3,400 acres of the total 147,990 acres of irrigable land are relatively flat. Of this, about 2,000 acres are made up of deep, well drained soils suited to all climatically adapted crops. In addition, 17,000 acres are deep and well drained but have limited crop adaptability due to moderate to rather steep slopes. Most of the remaining lands classified as irrigable have marginal value for the development of irrigated agriculture due to shallow depths, rockiness, and steep, complex topography.

Present Land Use

Lands within Mariposa County with various present uses were separated into five broad groups: irrigated lands, nonirrigated agricultural lands, recreation and urban lands, Yosemite National Park, and unsegregated land of various types of native vegetation. The acreage of each of these lands is indicated in Table 23, "Present Land Use Within Mariposa County".

Irrigated Lands

Irrigated lands comprise all agricultural lands which receive a supplemental water supply either by surface irrigation or by direct use from a high water table. The particular crop types, whether olives, corn, apples, mixed pasture, etc., were delineated on aerial photographs during the survey, but are all indicated by the symbol I on Plate 3. The gross delineations included all roads, farmsteads, canals, or other rights-of-way within the designated presently irrigated area. In 1959 there were 890 acres of irrigated lands in Mariposa County, including 390 acres of deciduous orchard, mostly apples; 80 acres of olives, grain and miscellaneous truck crops; and 420 acres of pasture.

Nonirrigated Agricultural Lands

Nonirrigated agricultural lands are composed of lands which are being used for agricultural purposes that do not receive a supplemental water supply, some of which are presently cropped and some of which are fallow. In 1959 there were 950 acres of nonirrigated agricultural lands in Mariposa County.

Urban Lands

Urban lands include the total area of towns, small communities, and industrial areas which are large enough to be delineated. These are

gross areas which include homes, streets, vacant lots, etc., and are not necessarily fully developed at the present time. There were 320 acres of urban lands in Mariposa County in 1959.

Recreation Lands

Lands placed in the recreation category include camp and trailer sites, permanent and summer home areas, motels and resorts, and other commercial establishments which are necessary to service these developments. These areas as delineated are not necessarily fully developed. In 1959 there were 150 acres of recreation residential lands, 70 acres of recreation commercial lands, and 110 acres of recreation campgrounds in Mariposa County.

Native Vegetation Lands

All lands which have not been included in the types of land use which have been described above, and which are not within the boundaries of Yosemite National Park, are included in the category of native vegetation. No land use surveys were conducted for lands lying within the boundaries of Yosemite National Park. There are 244,140 acres of Mariposa County lands within Yosemite National Park; and 691,720 acres of Mariposa County lands were classified as native vegetation.

Summary

The results of the 1959 land use survey of Mariposa County are shown in Table 23. Only about 890 acres out of a total county area of 938,350 acres are shown as presently irrigated lands. Of these 890 acres of presently irrigated land, 420 acres were in pasture, 390 acres were in deciduous orchard, and the remaining 80 acres were in olives, grain and miscellaneous truck crops. Practically all of the deciduous orchard

acreage was devoted to apples, and 150 acres of the pasture were meadow land receiving water from a natural high water table.

TABLE 23

PRESENT LAND USE WITHIN MARIPOSA COUNTY
(Based on 1959 land use survey)

Land use	Acres	Land use	Acres
Irrigated Land		Nonirrigated Agricultural Land	
Pasture	420	Deciduous orchard	90
Deciduous orchard	390	Citrus	20
Subtropical	40	Grain	720
Grain	20	Fallow	120
Truck	20	Total	950
Total	890		
Recreation and Urban Land		Yosemite National Park	244,140
Recreation residential	150	Native Vegetation	691,720
Recreation commercial	70		
Camp grounds	110		
Urban	320		
Total	650	Total County Area	938,350

Future Land Use

Estimates of patterns of possible future land use in Mariposa County were made following the land classification survey. Separate estimates were made for each of the following service areas: Chowchilla, Mariposa Creek, Bear Creek, Midpines, and Greeley-Coulterville.

The Mariposa Creek service area included four subareas; namely, Foothill, White Rock, Cathay, and Oakvale. These proposed service areas are shown on Plate 4, "Plans for Development".

Irrigable Lands

The land classification survey was reviewed with respect to topographic limitations which would influence future water supply developments. Areas of irrigable land were then tabulated, and reductions in acreages were made for farmsteads, rights-of-way, and other nonirrigable inclusions. The acreages of "project net irrigable land" were then estimated. They are summarized in the following tabulation:

Area	Irrigable Land (in acres)
Mariposa Creek Service Area:	
Foothill Subarea	5,060
White Rock Subarea	2,040
Cathay Subarea	7,370
Oakvale Subarea	4,180
Subtotal	18,650
Bear Creek Service Area	13,910
Greeley-Coulterville Service Area	3,520
Total	36,080

Although there are many small parcels of irrigable lands in the Chowchilla and Midpines service areas, most of the land in these areas is used as residential farmland.

Crop patterns. Possible patterns of land use were projected, based upon the classification of net irrigable lands and upon consideration of present development, climatic conditions, economic merits of various crops, and information gained from qualified persons engaged in agriculture. Projections were made for both the major irrigation season

(summer season) and the minor irrigation season (fall-winter-spring season).

Crops selected for the projection of the crop patterns are meant to serve only as a representative basis for estimating water requirements. Representative crops were selected after due consideration of the climate and the soils of the area, and the location of markets for crops. Peaches, walnuts, and almonds were selected to represent deciduous orchard crops; and tomatoes, peppers, cantaloupes, peas, and cauliflower were selected for truck crops. The results of these projections of irrigable land use in the future are presented in Table 24, "Estimated Future Crops in Mariposa County".

The patterns of land use projected for the service areas within Mariposa County represent a fruit and cattle economy. Mariposa County's agricultural development is now primarily devoted to livestock, and if water were made available this type of use would be expected to continue due to the proximity of the irrigable land to good range land and the limited crop adaptability of the irrigable land. A relatively small amount of truck crops probably would be grown to meet local demand, and the lands having deep soils and slight-to-moderate slopes might be devoted to fruit production.

Future Water Requirements

Water requirements for the proposed service areas are expressed in terms of urban, residential farm, and irrigation requirements. The requirements are the amounts needed at the service connection in the case of urban use, and at the farm headgate in the case of residential farms and irrigation use.

TABLE 24

ESTIMATED FUTURE CROPS IN MARIPOSA COUNTY
(In acres)

Crop	Mariposa Creek service area: Foothill subarea	Mariposa Creek service area: White Rock subarea	Mariposa Creek service area: Cathay subarea	Mariposa Creek service area: Oakvale subarea	Bear Creek service area	Greeley-Coulterville service area	Total
Orchard	1,750	650	1,850	650	2,200	900	8,000
Grape	600	--	--	--	--	--	600
Alfalfa	200	250	300	250	850	250	2,100
Pasture	900	740	4,170	2,880	9,410	1,820	19,920
Truck	900	--	--	--	--	--	900
Field	710	400	1,050	400	1,450	550	4,560
	5,060	2,040	7,370	4,180	13,910	3,520	36,080
Barley[1/]	460	280	735	280	1,015	385	3,155
Truck[1/]	690	--	--	--	--	--	690
	6,210	2,320	8,105	4,460	14,925	3,905	39,925

1/ Double cropped.

The estimates of water requirements for crops within Mariposa County are based on consumptive use information previously developed by the Department. Studies and measurements of crop consumptive use now under way in Kern County indicate that the values may be low and may be subject to upward revision. Field studies should be initiated in Mariposa County to ascertain the rates of consumptive use of the major crops adaptable to the area.

Urban Use

An urban requirement of 250 gallons per person per day was used for projecting urban water requirements. The per capita water requirement

was multiplied by the projected population to determine urban water requirements. An efficiency factor of 50 percent was applied to the water requirement to determine the consumptive use of urban water. The urban water requirement of the Mariposa subarea of the Mariposa Creek service area is expected to be 5,070 acre-feet annually by the year 2020. The following tabulation shows the estimated 2020 urban water requirements by proposed service areas.

Service Area	Urban Water Requirement (in acre-feet)
Chowchilla	1,200
Mariposa Creek	7,000
Midpines	900
Bear Creek	400
Greeley-Coulterville	300
TOTAL	9,800

Residential Farm Use

Estimates were made of water requirements for residential farm use, sometimes referred to as rural domestic use, based upon the concept that a supply would be made available for household domestic purposes and for farm or garden use. A residential farm unit water requirement of three acre-feet per acre was utilized in this report. The estimated residential farm water requirements by service areas for the year 2020 are as follows:

Service Area	Residential Farm Water Requirements (in acre-feet)
Chowchilla	1,400
Mariposa Creek	6,500
Midpines	1,000
Bear Creek	400
Greeley-Coulterville	1,800
TOTAL	11,100

Irrigation Use

Future irrigation water requirements for the service areas are based upon unit consumptive use data for the area published in Bulletin No. 2, State Water Resources Board, June 1955. The values for Hydrographic Unit 47 of Bulletin No. 2 were applied to all areas in Mariposa County except the Foothill subarea. The water requirement values for Hydrographic Unit 56 of Bulletin No. 2 were utilized for the Foothill subarea. The estimates of water requirements were based upon the efficiencies for each major land class, which in turn were based upon the consumptive use values for the respective crops.

The estimated irrigation water requirements within proposed service areas for the year 2020 are as follows:

Area	Irrigation Demand (in acre-feet)
Mariposa Creek Service Area:	
Foothill subarea	12,600
White Rock subarea	5,000
Cathay subarea	18,500
Oakvale subarea	11,100
Subtotal	47,200
Bear Creek Service Area	36,900
Greeley-Coulterville Service Area	8,800
TOTAL	92,900

Summary

Annual water requirements for Mariposa County in the year 2020 have been estimated to be 113,800 acre-feet, consisting of 9,800 acre-feet for urban use, 11,100 acre-feet for residential farm use, and 92,900 acre-feet for irrigation use. The great bulk of the water

requirement would be for areas lying south of the Merced River, and would amount to 103,000 acre-feet annually. North of the Merced River total water requirement would be 10,800 acre-feet.

CHAPTER IV. PLANS FOR WATER DEVELOPMENT

No one project would best fit both the short- and long-range estimated needs of the Mariposa area. The plan selected is composed of two elements: (1) local projects and (2) an areawide development of the Merced River.

The demand for supplemental water supplies in the Mariposa area is small at the present time and will probably increase at a comparatively slow rate in the near future. The short-range development of water resources is therefore expected to be limited to local projects.

The development of supplemental water supplies by means of local projects would stimulate the economic growth of the county, and at some time in the future additional water supplies would have to come from a larger areawide project. A plan for areawide development of the Merced River is presented which would fill this need when it occurs and which should be compatible with, and perhaps even enhance, the plans of the Merced Irrigation District for waters from this same source.

An agreement between the Merced Irrigation District and Mariposa County dated March 1, 1960, provides that permits issued to the District for its Merced River Development shall be subject to depletion of streamflow in the amount of 112,000 acre-feet per annum from South Fork Merced River, 4,000 acre-feet per annum from Maxwell Creek, and 1,200 acre-feet per annum from Bean Creek for beneficial use in Mariposa County. The agreement further provides that should diversion from South Fork Merced River be made pursuant to the agreement prior to the pay-out period of the revenue bonds for the project the District shall be compensated for the power revenue lost; and that the District will not protest or oppose any application to appropriate water of the Merced River or its tributaries

for use within Mariposa County for storage of an annual amount of 50 acre-feet or less, unless studies show that use under such application will encroach upon the then existing rights of the District.

In planning local projects, preliminary studies were made of many storage sites. Only quadrangle maps published by the U. S. Geological Survey were available for some sites; however, ten of the sites were mapped in more detail by the Department during the investigation. Surface geological inspections were made at many of the potential project areas, and some of these areas were investigated for availability of construction materials.

Four local projects were selected for present and near future consideration and are reported on in this bulletin. These projects represent a reasonable method of developing local water supplies to fill immediate needs and those estimated needs of approximately 30 years in the future. Two of the projects, Coulterville and Bean Creek, are located north of the Merced River within the Merced River Basin. The other two, Agua Fria and Norwegian Gulch, are located in the upper portions of the drainage basins of streams of the Eastern Merced County Stream Group.

Mariposa County Local Projects

Of the many dam and reservoir sites studied, four were found to be especially desirable because they satisfy either an immediate need, a need that is anticipated in the near future, or both. The Agua Fria Project, largest, most attractive, and most needed of the four, would conserve the water resources of Mariposa and Agua Fria Creeks. It would provide an outstanding recreation facility of statewide interest in addition to an urgently needed supplemental source of domestic water for the town of Mariposa, and also for the Catheys Valley area.

The Norwegian Gulch Project would conserve the water resources of Bear Creek for multiple-purpose uses. The Bear Valley area along the Mother Lode Highway (State Route 49), if provided an adequate water supply, has the potential for significant growth in small farm homesites and perhaps a subdivision-type development. The town of Hornitos might also obtain supplemental domestic water from this project since ground water supplies there will probably prove to be insufficient to provide much additional dependable yield. The Upper Bear Valley Project, a possible alternative to the Norwegian Gulch Project but somewhat smaller, is also described.

The Coulterville Project would conserve the surplus flows of Maxwell Creek for multiple-purpose uses. The reservoir site is located approximately one mile northeast of the town of Coulterville. This project would provide a supplementary source of water supply for domestic usage, including fire protection, a limited supplemental supply for agricultural purposes, and a small recreational reservoir for the area.

Bean Creek Project, the fourth local project, would conserve waters of Bean Creek. The project area is in the northern portion of Mariposa County near the boundary with Tuolumne County. The primary purpose would be the development of the excellent recreation potential of the area.

Agua Fria Project

The Agua Fria Project stood out from the beginning as the one with the highest potential. The Department of Water Resources was authorized by the Legislature in 1963 to conduct feasibility studies of and to prepare a feasibility report on the Agua Fria Project, subject to an agreement with the Mariposa County Water Agency to share the cost. In July 1963, an agreement was entered into and the following month the

Proposed Agua Fria Dam Site in foreground

Department began the assigned work. In August 1964, the Department published the results of that work as Bulletin No. 145, entitled "Agua Fria Investigation, Feasibility Study". A summary of Bulletin 145 follows.

The Agua Fria Project area has much to offer in the way of scenery, climate, and accessibility. Although there has been a lot of interest shown by retired people and prospective commuters in moving into the area, not many have done so. Lack of water has been a major cause of their hesitation. Wells are expensive to drill and ground water supplies are not dependable.

Much would be accomplished for the county by the creation of Agua Fria Reservoir with adequate recreation lands and facilities combined with the development of new, dependable water supplies and facilities to deliver that water to (1) planned rural homesite areas, (2) selected agricultural land of high potential, and (3) the town of Mariposa. The reservoir would provide the needed supplemental source of water supply to the town of Mariposa and a dependable supply of water to some residents of Catheys Valley whose pumps are at times running dry. The project would attract new residents and broaden the county tax base. Construction of the project and of new homes would vitalize the economy of the area, and the increasing influx of new residents and recreationists should keep it nourished.

The development of a dependable supplemental water supply for Catheys Valley was included in the project because of its importance in boosting the general economy of the county. Facilities required to service the Catheys Valley area are quite extensive, however, and would

Cathevs Valley service area with Stonehouse in foreground, extreme right

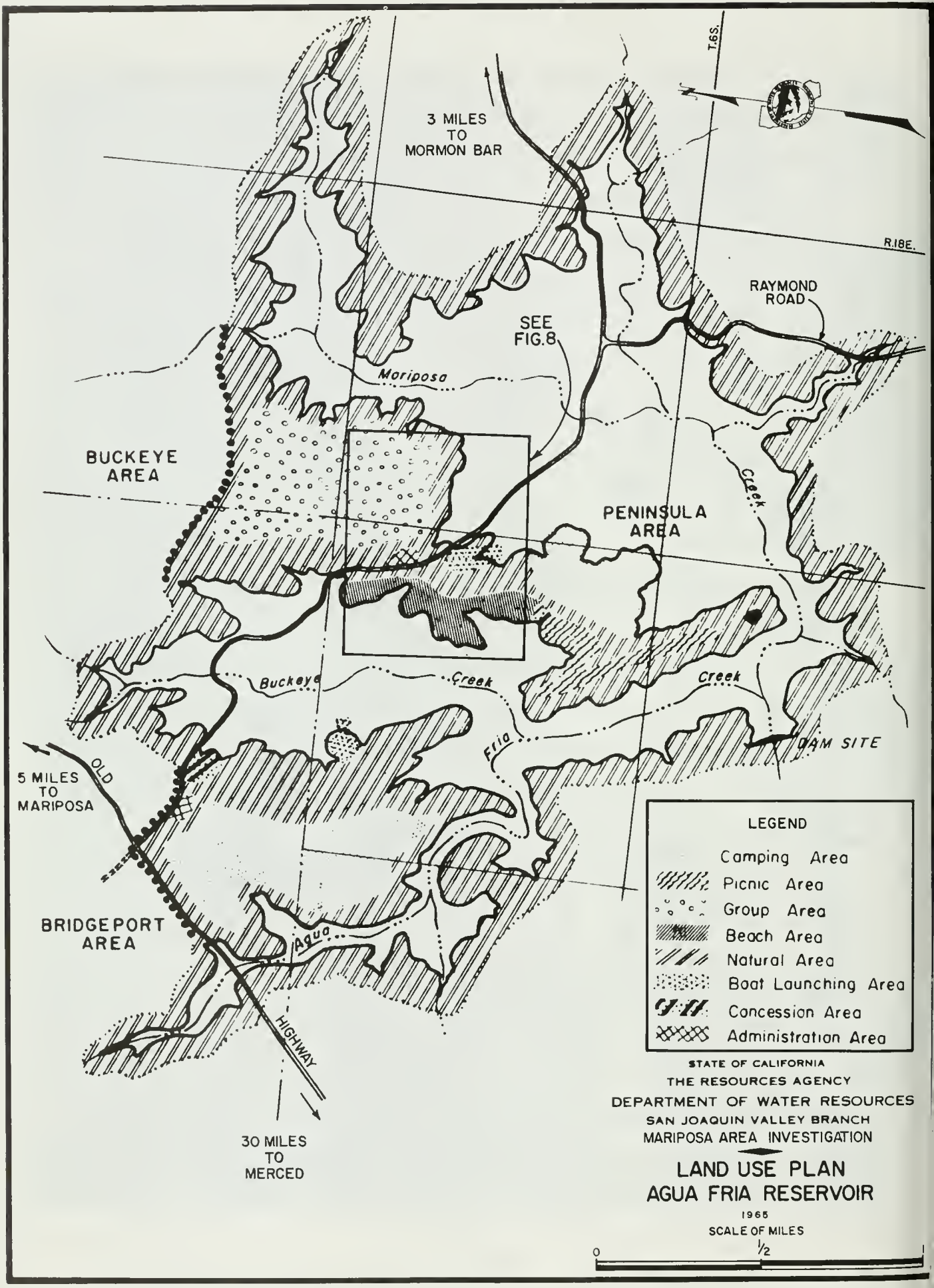
represent a considerable per capita investment for the presently limited county population. Therefore, sufficient information was included in the feasibility report so that the report could be analyzed independently of the Catheys Valley features.

Major features of the Agua Fria Project are shown on Plate 5. The 178-foot-high dam would create a 50,000-acre-foot capacity lake having a surface area of 1,260 acres and a shoreline of 24 miles. The reservoir drawdown would be limited to approximately 25 feet during the recreation season to develop near maximum potential for recreation and fish enhancement. On this basis the reservoir would provide a firm annual yield of 6,400 acre-feet in excess of regulated stream releases that were reserved for downstream users. It was estimated that this yield would not be fully utilized until about the year 2000, even including initial service to Catheys Valley.

A land-use plan, a plan of the recreation facilities, a chart showing the predicted recreation use, and tables depicting the critical portion of the reservoir operation study, the estimated project benefits, and the estimated project costs are included on the following pages. The benefit-cost ratio of better than 2 to 1 corroborated the earlier preliminary appraisals of the Agua Fria Project as one which seemed to offer above average potential.

Norwegian Gulch and Upper Bear Valley Projects

The people of Mariposa County have for many years studied ways and means to develop a recreation reservoir on Upper Bear Creek in the vicinity of its confluence with Norwegian Gulch. This site does not possess the outstanding surrounding locale for recreation advantages as does the proposed Agua Fria site.


T.6S.
R.18E.
3 MILES TO MORMON BAR
RAYMOND ROAD
SEE FIG.8
Mariposa
BUCKEYE AREA
PENINSULA AREA
Creek
Buckeye
Creek
Creek
Fria
DAM SITE
5 MILES TO MARIPOSA
OLD
BRIDGEPORT AREA
Aqua
HIGHWAY
30 MILES TO MERCED
LEGEND
Camping Area
Picnic Area
Group Area
Beach Area
Natural Area
Boat Launching Area
Concession Area
Administration Area
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION
LAND USE PLAN
AGUA FRIA RESERVOIR
1965
SCALE OF MILES
0
1/2
1

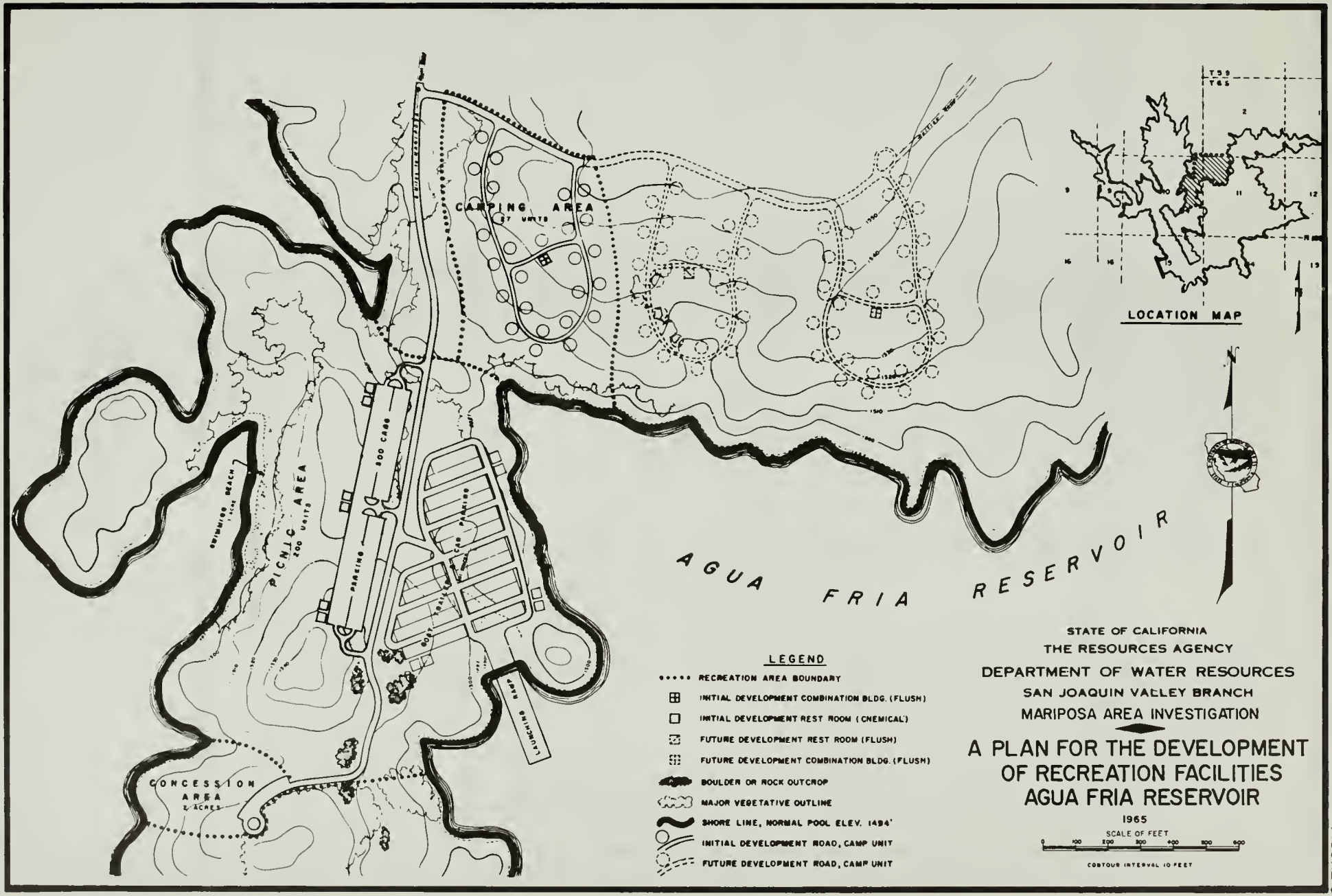
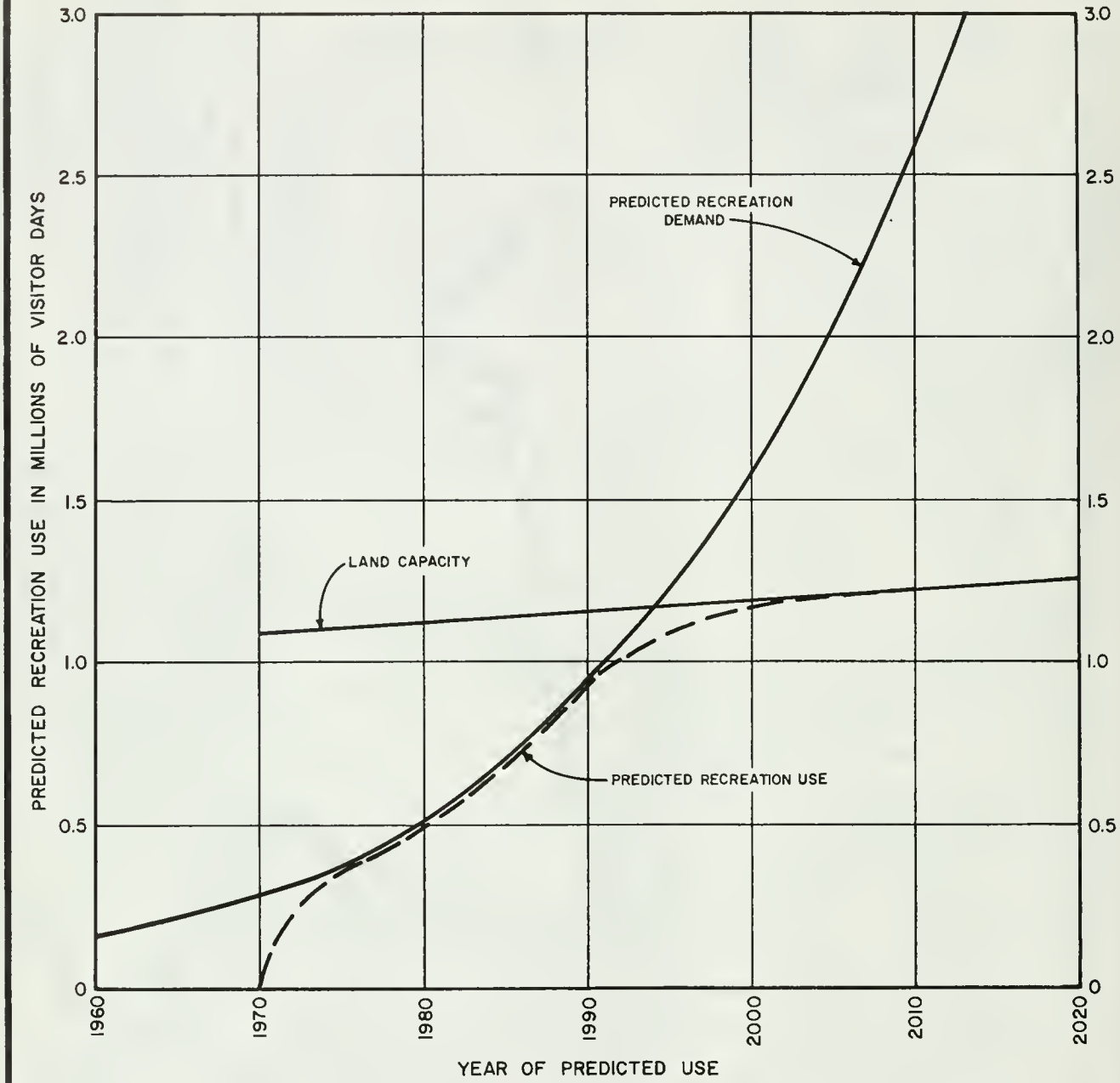

CAMPING AREA
37 UNITS
PICNIC AREA
200 UNITS
SWIMMING BEACH
1 ACRE
PARKING
200 CARS
BOAT LAUNCHING RAMP
LAUNCHING RAMP
CONCESSION AREA
2 ACRES
AGUA FRIA RESERVOIR
LOCATION MAP
T 3 S
T 4 S
LEGEND
RECREATION AREA BOUNDARY
INITIAL DEVELOPMENT COMBINATION BLDG. (FLUSH)
INITIAL DEVELOPMENT REST ROOM (CHEMICAL)
FUTURE DEVELOPMENT REST ROOM (FLUSH)
FUTURE DEVELOPMENT COMBINATION BLDG. (FLUSH)
BOULDER OR ROCK OUTCROP
MAJOR VEGETATIVE OUTLINE
SHORE LINE, NORMAL POOL ELEV. 1494'
INITIAL DEVELOPMENT ROAD, CAMP UNIT
FUTURE DEVELOPMENT ROAD, CAMP UNIT
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION
A PLAN FOR THE DEVELOPMENT OF RECREATION FACILITIES AGUA FRIA RESERVOIR
1965
SCALE OF FEET
0 100 200 300 400 500 600
CONTOUR INTERVAL 10 FEET

FIGURE 8



PREDICTED RECREATION USE
AGUA FRIA RESERVOIR

DEPARTMENT OF WATER RESOURCES SAN JOAQUIN VALLEY BRANCH 1964

TABLE 25

ANNUAL SUMMARY
OF YIELD STUDY, AGUA FRIA RESERVOIR
(In acre-feet)

Water year	Storage October 1	Runoff	Releases to stream	Project demand	Evaporation[1]	Spill	Storage[2] on July 1
1921-22	15,000[3]	43,140	4,020	6,400	2,830	4,970	46,560
1922-23	39,920	30,190	3,600	6,400	2,480	17,710	46,560
1923-24	39,920	1,650	1,160	6,400	2,160	0	37,630
1924-25	31,850	12,890	2,040	6,400	2,370	0	39,800
1925-26	33,930	6,150	1,350	6,400	2,230	0	35,800
1926-27	30,100	27,360	2,300	6,400	2,690	5,390	46,780
1927-28	40,680	15,710	2,370	6,400	2,571	5,136	46,564
1928-29	39,913	3,130	1,680	6,400	2,211	0	38,570
1929-30	32,752	4,960	1,590	6,400	2,040	0	33,100
1930-31	27,682	1,470	1,110	6,400	1,680	0	25,100
1931-32	19,962	27,610	2,120	6,400	2,565	0	42,502
1932-33	36,487	3,850	2,120	6,400	2,120	0	35,540
1933-34	29,697	3,000	1,290	6,400	2,120	0	28,610
1934-35	22,787	23,350	2,980	6,400	2,530	0	40,160
14-year Average	29,296	14,604	2,124	6,400	2,328	2,372	38,805
42-year Average (1921-1963)	39,910	21,073	2,389	6,400	2,395	9,291	41,705

1/ Based on average net effect of evaporation and precipitation.
2/ Indicates average storage during recreation season.
3/ Assumed beginning storage.

TABLE 26

SUMMARY OF AGUA FRIA PROJECT BENEFITS

Project purpose	Project benefits on basis of present worth					
	1970-80	1980-90	1990-2000	2000-10	2010-20	Total for 50-year period
A. Water Conservation						
1. Urban	$ 514,000	$ 794,000	$ 874,000	$ 712,000	$ 482,000	$ 3,376,000 1/
2. Rural Domestic	712,000	984,000	948,000	735,000	497,000	3,876,000 2/
3. Commercial Agricultural	54,000	198,000	134,000	33,000	23,000	442,000 3/
					Subtotal	$ 7,694,000
B. Recreation	2,466,000	4,065,000	4,771,000	3,376,000	2,383,000	17,061,000
C. Fish Enhancement	1,184,000	583,000	394,000	266,000	180,000	2,607,000
					TOTAL	$ 27,362,000

1/ Catheys Valley - - - - $ 408,000
Agua Fria-Mormon Bar - 364,000
Town of Mariposa - - - 2,604,000
Total $3,376,000

2/ Catheys Valley - - - - $2,176,000
Agua Fria-Mormon Bar - 1,700,000
Total $3,876,000

3/ Catheys Valley

TABLE 27

ESTIMATED TOTAL PROJECT COSTS
AGUA FRIA PROJECT
(Based on prices prevailing in the summer of 1963)

Item	Amount
Capital costs, dam and reservoir	$2,328,000
Capital costs of initial recreation facilities	395,000
Capital cost of initial water supply facilities	1,700,000 1/
Capital cost of initial fish stocking	8,000
Present worth of future expansions of recreation facilities	273,000
Present worth of future expansions of water supply facilities	583,000 2/
Present worth of all annual and operating costs, dam and reservoir	430,000
Present worth of annual and operating costs, recreation facilities	5,968,000
Present worth of annual and operating costs, water supply facilities	1,717,000 3/
Present worth of operation of preservation area	43,000
Total	$13,445,000

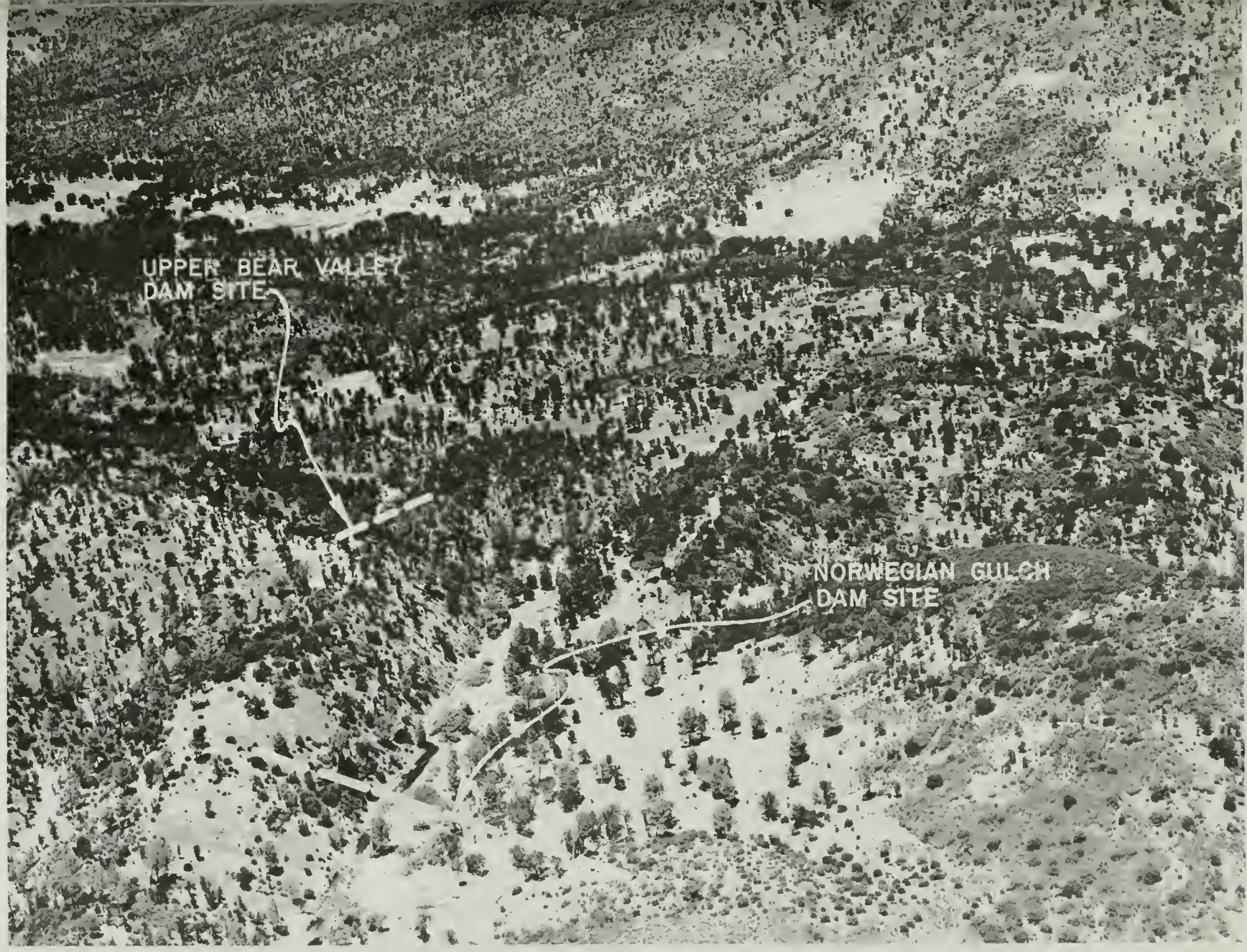
1/ Catheys Valley portion would be $1,120,000
2/ Catheys Valley portion would be $266,000
3/ Catheys Valley portion would be $760,000

The proposed Norwegian Gulch project would provide a supplemental water supply for the area and would develop the recreation potential of the site. To achieve maximum recreation benefits, the proposed reservoir would be stocked with fish, the surrounding area would be developed for camping and picnicking, and boating and swimming facilities would be installed. Water supplies conserved in this reservoir would be conveyed in a pipeline to the vicinity of El Dorado Creek near Hornitos for residential-farm use and to the town of Hornitos for municipal use. A water supply for the town of Bear Valley could also be provided. Some incidental benefits would be derived from flood control and soil erosion control along Bear Creek.

The proposed Upper Bear Valley Project would be an alternative to the proposed Norwegian Gulch Project. This dam and reservoir would lie entirely within the area that would be inundated by the proposed Norwegian Gulch Reservoir.

Information gathered during this investigation suggests that the development of the larger proposed project at the Norwegian Gulch site might be difficult to justify for construction within the near future, especially if Agua Fria were developed first. Because of the inadequacy of the water supply for both the Bear Valley and Hornitos areas, a proposed water conservation project for this general area was considered. The Upper Bear Valley Project is less costly than the Norwegian Gulch Project from the standpoint of water supply considerations alone, and for this reason is included.

Bear Creek is an intermittent stream draining a secondary watershed between the Merced and Chowchilla Rivers. The drainage area tributary to the proposed Norwegian Gulch Reservoir consists of 15.4 square miles of hilly topography ranging in elevation from 1,700 feet to 4,000 feet. The watershed is below the snowline and runoff is derived primarily from rainfall.



Proposed Norwegian Gulch and Upper Bear Valley Dam Sites

The Town of Hornitos service area

A stream gaging station was established on Bear Creek about five miles downstream from the proposed damsites during the investigation, and records of runoff at this station are presented in Table 18 of Chapter II. Lines of equal mean precipitation indicate that runoff at the Upper Bear Valley and the Norwegian Gulch sites would have the same characteristics and would be approximately proportional to their respective drainage areas. The drainage area of the Norwegian Gulch site is 15.4 square miles and that of the Upper Bear Valley site is 12.4 square miles. The water supply for the alternative site would therefore be about 80 percent of that estimated for the Norwegian Gulch Project.

Previous Investigations. The only reports of comprehensive water resource investigations which have included the Bear Valley and Hornitos areas of Mariposa County are Bulletin No. 3, "The California Water Plan", and Bulletin No. 56, "Survey of Mountainous Areas", published respectively by the Department of Water Resources, and its predecessor agency, the Division of Water Resources, Department of Public Works. The following is taken from Bulletin No. 56:

> "Bear Creek Dam and Reservoir would be constructed on Bear Creek at a site located about 5 miles south of the town of Bear Valley. Stream bed elevation at the site of the proposed dam is approximately 1,615 feet. The storage capacity of the reservoir would be about 22,000 acre-feet. Water released from the reservoir would be conveyed by canals to supply irrigable lands in the Hornitos Service Area."

The source of water supply for this proposed reservoir would be the South Fork of the Merced River.

Bulletin No. 3 stated the following in regard to development in this area:

> "Water diverted from the South Fork of the Merced River at the Wawona diversion would be conveyed westerly in a tunnel into the upper watershed of the Chowchilla River Basin. As

the water would be conveyed across the upper Chowchilla River watershed, some releases would be made for local application and to regulatory storage reservoirs in this basin, as is subsequently described. However, the major portion of the water would be conveyed out of the watershed and discharged into Agua Fria and Upper Bear Creek Reservoirs, located on Mariposa Creek and Bear Creek, respectively, and served to the lands in the vicinity of the two reservoirs."

The Upper Bear Creek Dam proposed in Bulletin No. 3 would have a gross storage capacity of 50,000 acre-feet and an estimated capital cost of $3,416,000. The proposed damsite would be located on Bear Creek at a point about one mile downstream from the confluence with Norwegian Gulch. Geological studies conducted during this investigation indicate that the cost of constructing this large dam would be higher than previously estimated because of the scarcity of impervious earthen materials.

Dam and Reservoir. Topographic mapping of the damsites and reservoir areas was conducted by the Department of Water Resources. The mapping was done by photogrammetric methods with a scale of 1 inch to 400 feet and a contour interval of 10 feet. The damsite topography was enlarged to a scale of 1 inch to 100 feet.

A summary of the general features of three possible sizes of the Norwegian Gulch Project is shown in Table 28, "General Features, Norwegian Gulch Project". The water supply from the reservoirs would be conveyed to the place of use in the El Dorado Creek drainage area through 5 miles of 15-inch pipeline, and an additional 4 miles to the vicinity of Hornitos through a 6-inch pipeline. The general layout of the Norwegian Gulch Project is shown on Plate 6.

The general features of three possible sizes of the Upper Bear Valley Project are shown in Table 29, "General Features, Upper Bear Valley Project". Pipelines would be practically the same as for the Norwegian Gulch Project. The general layout of the Upper Bear Valley Project is

TABLE 28

GENERAL FEATURES, NORWEGIAN GULCH PROJECT

Item	Reservoir storage capacity, in acre-feet: 7,000	5,100	3,000
Norwegian Gulch Dam			
Type of dam	(rockfill with central impervious core)		
Crest elevation, in feet	1,825	1,815	1,800
Crest length, in feet	950	840	790
Crest width, in feet	30	30	30
Height, spillway lip above streambed, in feet	105	95	80
Side slopes, upstream	2.75:1	2.75:1	2.75:1
Side slopes, downstream	2.5:1	2.5:1	2.5:1
Freeboard above spillway, in feet	5	5	5
Elevation of streambed, in feet	1,715	1,715	1,715
Volume of fill, in cubic yards	650,000	518,000	348,000
Norwegian Gulch Reservoir			
Surface area at normal pool, in acres	214	170	116
Surface area at maximum 25-foot drawdown, in acres	116	88	52
Drainage area, in square miles	15.4	15.4	15.4
Type of spillway	overpour	overpour	overpour
Spillway discharge capacity, in second-feet	11,000	11,000	11,000
Type of outlet	(pipeline beneath dam)		
Conduit to Hornitos			
Types of conduit: Approximately 5 miles of 15-inch pipeline to El Dorado Creek, and 4 miles of 6-inch pipeline to Hornitos.			
Intake elevation below dam, in feet	1,720		
Discharge elevation on El Dorado Creek, in feet	1,520		
Discharge elevation for Hornitos, in feet	1,120		

TABLE 29

GENERAL FEATURES, UPPER BEAR VALLEY PROJECT

Item	Reservoir storage capacity, in acre-feet		
	2,500	2,050	1,650
Upper Bear Valley Dam			
Type of dam	(rockfill with central impervious core)		
Crest elevation, in feet	1,810	1,805	1,800
Crest length, in feet	630	520	480
Crest width, in feet	20	20	20
Height, spillway lip above streambed, in feet	70	65	60
Side slopes, upstream	2.75:1	2.75:1	2.75:1
Side slopes, downstream	2.5:1	2.5:1	2.5:1
Freeboard above spillway, in feet	5	5	5
Elevation of stream bed, in feet	1,735	1,735	1,735
Volume of fill, in cubic yards	195,000	162,000	138,000
Upper Bear Valley Reservoir			
Surface area at normal pool, in acres	100	88	76
Surface area with 25-foot drawdown, in acres	48	38	30
Drainage area, in square miles	12.4	12.4	12.4
Type of spillway	overpour	overpour	overpour
Spillway discharge capacity, in second-feet	9,000	9,000	9,000
Type of outlet	(pipeline beneath dam)		
Conduit to Hornitos			
Types of conduit -- Approximately 5 miles of 15-inch pipeline to El Dorado Creek, and 4 miles of 6-inch pipeline to Hornitos.			
Intake elevation below dam, in feet	1,740	1,740	1,740
Discharge elevation on El Dorado Creek, in feet	1,520	1,520	1,520
Discharge elevation near Hornitos, in feet	1,120	1,120	1,120

also shown on Plate 6. Preliminary designs are based on findings of a surface geological investigation of the sites conducted by the Department. The sites were not drilled to confirm the findings.

Both damsites are underlain by black slate of the Mariposa Formation. The slate is thinly bedded, fissile, moderately hard, and subject to intense slumping and weathering on steep slopes. Where the slate is unweathered, it is fairly tight and should provide a suitable foundation for a dam. The strike is north 40° west at both sites, and the dip is vertical to 60° northeasterly at the Norwegian Gulch site and 90° at Upper Bear Valley. Spillway lining will probably be necessary at either location because of the position of bedding planes with respect to spillway cuts. The reservoir area is entirely underlain by the Mariposa slate formation, and seepage would be negligible.

The type of dam suggested at either site is rockfill with impervious earthen central core. Impervious construction materials appear to be lacking near each damsite. The soil development on the slate appears to be very shallow. Perhaps the nearest source for impervious material would be the Shanghai Ridge area, eight miles by road to the southwest. The material there is a decomposed granitic rock having the character of a silty sand. The rockfill of pervious zones of the proposed dam would be composed of quarried rock from the spillway, stream cobbles, random stream gravels, and dredger tailings from near the site. Filter material would be obtained by processing the nearby dredger tailings. Should a deposit of well-graded gravels be found, this processing could be eliminated. The foundation underneath the impervious central core would be grouted.

Stripping would consist of about two feet of top soil and about three feet of fractured rock on the abutments, and five feet of gravel in

the channel section. An additional three feet of weathered rock would have to be stripped in the channel under the impervious earthen core.

The spillway at Norwegian Gulch would be located on the long ridge on the west side of the dam. A concrete weir would be placed in the flat quarry area where random pervious material would be excavated for the construction of the dam. Maximum depth of water on the weir would be four feet and would provide for the maximum probable discharge of 11,000 second-feet with one foot of residual freeboard. Additional flood routing studies may allow a reduction in capacity of this spillway.

The spillway at Upper Bear Valley would be located in a saddle to the east of the dam. The saddle would be excavated for a width of 350 feet, and a weir two feet in height would be constructed across the benched area. The maximum depth of water over the weir would be four feet, and would provide for a maximum probable discharge of 9,000 second-feet with one foot residual freeboard. Residual freeboard over the standard project flood would be three feet. Additional flood routing studies would undoubtedly allow a reduction in the size of spillway as presented in this report.

Accomplishments. Several studies were made of accomplishments for various sizes of dams and reservoirs at both the Norwegian Gulch site and the alternative Upper Bear Valley site.

Studies of a cursory nature were made of the recreation potential which might be realized from the Norwegian Gulch development. In general, the site is not nearly as attractive as Agua Fria for a large recreation development. A detailed analysis was not made for the Norwegian Gulch site as was done at the Agua Fria Project. The comparative estimates for the Norwegian Gulch site are a matter of judgment on the part of recreation planners familiar with the area and its recreation potential.

A reservoir at Norwegian Gulch, insofar as recreation is concerned, would be in direct competition with the proposed Agua Fria Reservoir. The effects of this competition were estimated from a number of factors such as accessibility, attractiveness, site utility, and recreation space.

The accessibility of the Norwegian Gulch site is not as favorable as that of the Agua Fria site. Travel time from the Merced area would be about one-third greater. There would be only one area near Highway 49 which would have good access to the water's edge at the Norwegian Gulch site as compared to three large areas at Agua Fria with good access to the reservoir shoreline.

The surface area of Norwegian Gulch Reservoir would be very small compared with Agua Fria Reservoir. The largest reservoir presented for Norwegian Gulch would have a maximum water surface area of 214 acres compared to 1,260 acres at Agua Fria. Biological considerations suggest productivity of the fishery per surface acre would be much lower for Norwegian Gulch Reservoir than for one at Agua Fria.

The steeper and more rugged shores of the proposed Norwegian Gulch site would limit the swimming use. Most reservoir-associated picnicking is usually dependent upon swimming. The average width of proposed Norwegian Gulch Reservoir would be less than 500 feet, and this factor would be unfavorable to the boater or water skier.

It is evident that the combined effect of poor boating and water skiing, poor swimming and picnicking, together with the low-level fishery productivity, would result in a low utility for recreation use at the proposed Norwegian Gulch Reservoir. On the basis of the above factors the

competitive standing of Norwegian Gulch would be very low in comparison to Agua Fria, and most of the recreation demand would occur at Agua Fria. More detailed recreation studies are necessary for the Norwegian Gulch site before a monetary value could be assigned to recreation benefits.

The recreation features of the proposed reservoirs at the Upper Bear Valley site were compared with the corresponding features of the larger Norwegian Gulch reservoirs to demonstrate the advantages of the larger development. A comparison of the recreation features of the middle-sized reservoir at each site is shown in Table 30, "Comparison of Recreation Features of Norwegian Gulch and Upper Bear Valley Reservoirs".

TABLE 30

COMPARISON OF RECREATION FEATURES OF
NORWEGIAN GULCH AND UPPER BEAR VALLEY RESERVOIRS

(Based on the middle size reservoir for each site)

Feature	Norwegian Gulch	Upper Bear Valley
Water surface area at normal pool, in acres	170	88
Water surface area at minimum pool, in acres	88	38
Length of shoreline with slope less than 20 percent, in feet	17,700	9.100

Storage capacities of the Norwegian Gulch and the Upper Bear Valley Reservoirs at various stages of water surface elevations are given in Table 31, "Areas and Capacities of Norwegian Gulch Reservoir", and in Table 32, "Areas and Capacities of Upper Bear Valley Reservoir".

TABLE 31

AREAS AND CAPACITIES OF NORWEGIAN GULCH RESERVOIR

Water surface elevation, USGS datum, in feet	Depth of water at dam, in feet	Water surface area, in acres	Storage capacity, in acre-feet
1,730	15	2	10
1,740	25	9	120
1,750	35	18	200
1,760	45	32	450
1,770	55	52	900
1,780	65	76	1,500
1,790	75	100	2,400
1,800	85	134	3,600
1,810	95	170	5,100
1,820	105	212	7,000

TABLE 32

AREAS AND CAPACITIES OF UPPER BEAR VALLEY RESERVOIR

Water surface elevation, USGS datum, in feet	Depth of water at dam, in feet	Water surface area, in acres	Storage capacity, in acre-feet
1,735	0	0	0
1,745	10	3	10
1,755	20	10	74
1,765	30	22	220
1,775	40	38	520
1,785	50	56	1,000
1,795	60	76	1,650
1,805	70	100	2,520

The Upper Bear Creek and Hornitos areas are perhaps the most water deficient areas of Mariposa County. It is estimated that there are 13,910 acres of irrigable lands within these areas. About 1,560 acres of this land have soil suitable for the development of deciduous and sub-tropical orchards, but additional information should be obtained regarding climatic adaptability of orchards. Most of the lands appear to be best adapted for development as irrigated pasture because of the shallow depths of tillable soils.

At the end of a ten-year development period the annual demands for water are estimated to be 200 acre-feet for urban use and 290 acre-feet for residential-farm type developments. The balance of the water supply for any of the three sizes of either project could possibly be utilized for irrigation of orchards and pasture.

Operation studies were made for reservoirs at the Norwegian Gulch site with gross storage capacities of 7,000 acre-feet, 5,000 acre-feet, and 3,000 acre-feet. To preserve the utility of boating and other recreation aspects of the site, the maximum drawdown of each size of reservoir was limited to 25 feet during the recreation season. The results of operation studies are shown in Table 33, "Results of Operations Studies, Norwegian Gulch Reservoir".

TABLE 33

RESULTS OF OPERATIONS STUDIES, NORWEGIAN GULCH RESERVOIRS
(In acre-feet)

Item	Reservoir storage capacity		
	7,000	5,000	3,000
Active storage capacity	4,000	3,200	2,100
Average annual evaporation	600	500	300
Estimated safe annual yield	2,500	2,300	2,200

Reservoir sizes were considered for the Upper Bear Valley site with gross storage capacities of 2,500 acre-feet, 2,050 acre-feet, and 1,650 acre-feet. The operation of the proposed Upper Bear Valley Reservoir was also limited to a maximum drawdown of 25 feet to preserve the utility of boating facilities and other recreation aspects of the site. The estimated safe annual yield for each capacity was determined to be 1,840 acre-feet, 1,750 acre-feet, and 1,660 acre-feet, respectively. The results of these operations studies are shown in Table 34, "Results of Operations Studies, Upper Bear Valley Reservoirs".

TABLE 34

RESULTS OF OPERATIONS STUDIES, UPPER BEAR VALLEY RESERVOIRS
(In acre-feet)

Item	Reservoir storage capacity		
	2,500	2,050	1,650
Active storage capacity	1,750	1,550	1,300
Average annual evaporation	260	220	190
Estimated safe annual yield	1,840	1,750	1,660

Estimated Costs. Preliminary estimates of costs were made for three sizes of dam and reservoir at the Norwegian Gulch site and at the alternative Upper Bear Valley site. Estimates of cost were also made for the proposed conduit to the vicinity of Hornitos. A summary of the principal items of estimated capital and annual costs is presented in Table 35 for the Norwegian Gulch Project and in Table 36 for the Upper Bear Valley Project.

An analysis of the cost per acre-foot of yield for the three capacities at each location indicates that the 2,050 acre-foot capacity

TABLE 35

ESTIMATED CAPITAL AND ANNUAL COSTS
NORWEGIAN GULCH PROJECT

(Based on prices prevailing in the fall of 1960)

Item	Reservoir storage capacity, in acre-feet		
	7,000	5,000	3,000
CAPITAL COSTS			
Dam and reservoir			
Reservoir	$ 75,000	$ 58,000	$ 36,500
Dam	930,500	784,400	531,000
Spillway	79,600	79,600	79,600
Outlet works	41,800	36,250	29,750
Unlisted items	56,300	47,900	33,800
Subtotal	$1,183,200	$1,006,150	$ 710,650
Contingencies, 15 percent	177,500	150,900	106,600
Engineering & administration, 15 percent	204,100	173,500	122,600
Interest during construction, 2 percent	31,300	26,600	18,800
Subtotal	$1,596,100	$1,357,150	$ 958,650
Conduit			
Acquisition	$ 5,000	$ 5,000	$ 5,000
Pipeline to El Dorado Creek	239,000	221,500	205,000
Pipeline to Hornitos	51,500	51,500	51,500
Unlisted items, 5 percent	14,800	13,900	13,100
Subtotal	$ 300,300	$ 291,900	$ 274,600
Contingencies, 15 percent	$ 45,000	$ 43,700	$ 41,200
Engineering & administration, 15 percent	51,800	50,300	47,400
Interest during construction, 2 percent	7,900	7,700	7,300
Subtotal	$ 405,000	$ 393,600	$ 370,500
TOTAL	$2,001,100	$1,750,750	$1,329,150
ANNUAL COSTS			
Interest, 4 percent	$ 80,000	$ 70,000	$ 53,200
Repayment, 0.655 percent	13,100	11,500	8,700
Replacement, dam, 0.07 percent	1,100	900	700
Replacement, conduit, 1.00 percent	4,100	3,900	3,700
Operation and maintenance	1,400	1,000	600
General expense, 0.32 percent	6,400	5,600	4,200
TOTAL	$ 106,100	$ 92,900	$ 71,100

TABLE 36

ESTIMATED CAPITAL AND ANNUAL COSTS
UPPER BEAR VALLEY PROJECT

(Based on prices prevailing in the fall of 1960)

Item	Reservoir storage capacity, in acre-feet		
	2,500	2,050	1,650
CAPITAL COSTS			
Dam and reservoir			
Reservoir	$ 33,000	$ 29,400	$ 25,800
Dam	292,830	238,100	191,250
Spillway	35,100	39,100	74,100
Outlet Works	15,810	15,200	14,630
Unlisted items, 5 percent	18,800	16,100	15,300
Subtotal	$395,540	$337,900	$321,080
Contingencies, 15 percent	59,320	50,680	48,160
Engineering and administration, 15 percent	68,230	58,290	55,390
Interest during construction, 2 percent	10,460	8,930	8,490
Subtotal	$533,550	$455,800	$433,120
Conduit			
Acquisition	$ 5,000	$ 5,000	$ 5,000
Pipeline to El Dorado Creek	171,800	162,500	154,000
Pipeline to Hornitos	51,500	51,500	51,500
Unlisted items, 5 percent	11,410	10,950	10,520
Subtotal	$239,710	$229,950	$221,020
Contingencies, 15 percent	35,950	34,490	33,150
Engineering and administration, 15 percent	41,350	39,670	38,120
Interest during construction, 2 percent	6,320	6,040	5,840
Subtotal	$323,330	$310,150	$298,130
TOTAL	$856,880	$765,950	$731,250
ANNUAL COSTS			
Interest 4 percent	$ 34,300	$ 30,600	$ 29,200
Repayment, 0.655 percent	5,620	5,020	4,800
Replacement, dam, 0.07 percent	400	300	300
Replacement, conduit, 1.00 percent	3,230	3,100	2,980
Operation and maintenance	500	400	300
General expense, 0.32 percent	2,740	2,450	2,340
TOTAL	$ 46,790	$ 41,870	$ 39,920

development at the Upper Bear Valley site would provide the least costly yield per acre-foot.

A monetary evaluation was not made of the recreation benefits which would be associated with either project. A detailed analysis of the recreation potential at these sites would be necessary to ascertain whether recreation should be considered.

Coulterville Project

The town of Coulterville is located in northwestern Mariposa County at the crossing of State Highways 49 and 132. This town played a very important part in the development of the Mother Lode Country, and, at one time, had a population of more than 10,000 people. At that time the Coulterville Toll Road was the only road into Yosemite Valley. There has been a decline of the mining industry over the course of the last 110 years and at the present time this industry is of little consequence to the local economy. The future economic growth of this area should now probably be based on the attraction of Coulterville for tourists interested in the historical buildings and other features of historical importance.

The only significant source of local water supply for the town of Coulterville is Maxwell Creek. It is a small intermittent stream located in the vicinity of Coulterville and is tributary to the Merced River at Horseshoe Bend. The drainage area above the proposed Coulterville damsite consists of 17.3 square miles of hilly topography ranging in elevation from 1,800 feet to 3,300 feet. All of the watershed is below the snowline.

A stream gaging station was established by the Department on Maxwell Creek at the proposed damsite in the fall of 1958 and is still

being maintained. The record of runoff at this station, Maxwell Creek at Coulterville, is contained in Table 19 of Chapter II.

During the course of the water rights hearings before the State Water Rights Board on Merced Irrigation District Applications No. 16186 and No. 16187 for the appropriation of water from the Merced River, Mariposa County obtained water rights reservations for the Coulterville area as follows:

> "From Maxwell Creek a maximum of 34,000 acre-feet of water in any consecutive 10-year period and a maximum of 4,000 acre-feet of water in any one year period to be directly diverted to beneficial use and/or diverted to storage to later be applied to beneficial use."

The primary purpose of the proposed Coulterville Project would be to provide a supplemental water supply for the municipal and residential farm requirements of the Coulterville area. The area of possible water service for agricultural purposes would probably be between the town of Coulterville and the East Fork of Piney Creek.

Previous Investigations. Previous investigations for providing supplemental water supplies for the Greeley-Coulterville area have been conducted by the Department of Water Resources. The following quotation is taken from Bulletin No. 56, "Survey of Mountainous Areas", dated December 1955:

> "Hardin Flat Dam would be constructed at a site on the South Fork of the Tuolumne River near Hardin Ranch, where the stream bed elevation is approximately 3,460 feet. The storage capacity of the reservoir would be about 40,000 acre-feet. Water conserved by the reservoir would be released to the existing but improved Groveland Ditch, and conveyed to irrigable lands in the Groveland Service Area. About 10 miles below Hardin Flat Dam water would be diverted from the Groveland Ditch and conveyed southwesterly through proposed canals to serve water to irrigable lands in the Hardin, Blanchard, and Baxter Service Areas."

The following quotation is taken from Bulletin No. 3, "The California Water Plan", dated 1957:

"Works on the South Fork of the Tuolumne River would consist of Harden Flat and Burch Meadows Reservoirs. These reservoirs would serve water to irrigable lands in the basin which lie south of the main river, and would furnish a limited quantity of water for export to offstream storage in Mariposa County."

There does not appear to be justification at the present time for additional work to be done in regard to this possible future diversion of water from the South Fork of the Tuolumne River.

Dam and Reservoir. The proposed Coulterville Dam would be located in the east half of Section 34, Township 2 South, Range 16 East, MDB&M. The streambed elevation of Maxwell Creek at this point is 1,804 feet, U.S.G.S. datum. A topographic survey was made of the damsite at a scale of 1 inch equals 200 feet and a contour interval of 20 feet. A topographic survey of the proposed reservoir area was not made. Capacities of the reservoir were determined from U.S.G.S. Coulterville quadrangle. Storage capacities of the Coulterville Reservoir at various stages of water surface elevation are given in Table 37.

TABLE 37

AREAS AND CAPACITIES OF COULTERVILLE RESERVOIR

Depth of water at dam, in feet	Water surface elevation, U.S.G.S. datum in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	1,800	0	0
30	1,830	1	25
40	1,840	10	100
50	1,850	20	200
60	1,860	30	450
70	1,870	40	750
80	1,880	54	1,370
90	1,890	69	2,000
100	1,900	87	2,770
110	1,910	107	3,730
120	1,920	128	4,860
130	1,930	150	6,220

Preliminary designs were based on findings of a surface geological investigation of the site conducted by the Department. The site was not drilled to confirm the findings of the characteristics of the material exposed on the surface. The damsite is underlain by metavolcanic rocks and schist of the Calaveras group. The metavolcanic rocks are generally dark green, massive, very hard, and highly fractured near the surface. They are well exposed in a road cut on the right abutment, and underlie much of the proposed reservoir area. The schist is a hard, locally sheared rock; its schistosity strikes northwest and dips vertically.

The type of dam suggested for the Coulterville damsite is rockfilled with impervious earthen central core. The quantity of impervious earthfill material available should be sufficient for a small dam. Pervious material could probably be obtained from excavation at the spillway site in the left abutment and from stripping salvage. Transition material would be processed from the quarry. The amount of grouting required beneath the impervious section should be light to moderate.

The foundation at the site appears suitable for the proposed rockfill structure. Little stripping would be required in the channel and only moderate amounts of stripping would be required on the abutments. The side channel spillway proposed for the damsite would be cut into the schist on the left abutment. The schistosity is parallel to the centerline of the proposed spillway cut, and an unlined spillway would appear to be feasible.

The proposed spillway would be located on the floor of the proposed quarry which would provide rockfill material. The maximum depth of water above the 200-foot-long weir would be 7.5 feet. This would provide for the maximum probable discharge of 15,200 second-feet with a residual freeboard of 0.5 feet. Residual freeboard over the

standard project flood of 5,400 second-feet would be 5.3 feet. Additional flood routing studies would probably allow a reduction in the size of the spillway.

The general layout of the Coulterville Project and preliminary design of the larger of two dams which were considered is shown on Plate 7. The larger dam would be about 98 feet in height. An alternative dam which was also studied would be about 68 feet in height and would have a similar design.

Accomplishments. Several preliminary studies were made of costs and accomplishments for various sizes of dam and reservoir at the proposed site. The studies included an analysis of the effect of limiting the amount of drawdown of the water surface of proposed reservoirs during dry periods to enhance the recreation potential of the site.

The recreation potential of a possible reservoir at the proposed Coulterville site would be very small. Since the primary purpose of the reservoir would be the conservation of water for domestic purposes, recreation use of the reservoir would probably be limited to shoreline fishing, and perhaps some camping and boating. Recreation planners have estimated that if fishing were allowed, the annual use would probably not exceed about 2,000 visitor-days.

A 2,000-acre-foot reservoir at this site would provide a firm yield of about 900 acre-feet annually which would meet the 1990 requirements of 200 acre-feet for municipal and industrial use at Coulterville, 100 acre-feet for residential-farm users in the area, and about 600 acre-feet for agricultural uses. A 400-acre-foot reservoir would yield about 300 acre-feet annually.

The yields of the Coulterville projects are predicated on net inflow to the reservoir taking into consideration the existing McMahon Reservoir located about two miles downstream. An annual summary of the yield of this 2,000 acre-foot Coulterville project is shown in Table 38.

The general features and accomplishments of the two projects are listed in Table 39, "General Features and Accomplishments, Coulterville Project".

TABLE 38

ANNUAL SUMMARY OF YIELD STUDY, COULTERVILLE PROJECT
(In acre-feet)

Water year	Water supply				Distribution of water supply		
	Storage Oct. 1	Runoff	Downstream releases 1/	Net runoff at damsite	Evaporation	Yield	Spill
1921-1922	-----	4,600	0	4,600	198	900	3,370
-23	1,250	2,740	2	2,738	198	900	1,640
-24	1,250	940	219	721	168	900	0
-25	665	3,230	30	3,200	198	900	1,755
1925-1926	1,362	1,680	0	1,680	198	900	582
-27	1,012	3,670	70	3,600	198	900	2,502
-28	1,200	2,330	42	2,288	198	900	1,190
-29	1,050	1,140	169	971	198	900	0
-30	1,023	1,532	62	1,468	178	900	263
1930-1931	1,090	990	139	851	198	900	0
-32	795	2,890	10	3,880	168	900	2,565
-33	1,082	1,080	189	891	196	900	0
-34	907	1,090	189	901	163	900	0
-35	640	4,490	90	4,400	164	900	2,931

1/ An attempt has been made to preserve the estimated conservation accomplishments of the existing McMahon Reservoir which is located downstream. This study is not presented as being in accord with existing water rights, however.

TABLE 39

GENERAL FEATURES AND ACCOMPLISHMENTS,
COULTERVILLE PROJECT

Item	Reservoir storage capacity, in acre-feet: 2,000	: 400
Coulterville Dam		
Type	Rockfill with central earthen core	
Crest elevation, in feet	1,898	1,868
Crest length, in feet	530	370
Crest width, in feet	30	30
Height of spillway above streambed, in feet	90	60
Side slopes	2:1 upstream and downstream	
Freeboard above spillway lip, in feet	8	8
Elevation of streambed, in feet	1,800	1,800
Volume of fill, in cubic yards	194,000	77,000
Coulterville Reservoir		
Surface area at spillway lip, in acres	69	27
Drainage area, in square miles	12.9	12.9
Estimated mean annual runoff, in acre-feet	3,100	3,100
Yield with full drawdown, in acre-feet	900	300
Type of spillway	Side channel	
Spillway discharge capacity, in second-feet	15,200	15,200
Type of outlet	Pipe beneath dam	
Conduit to Piney Creek		
Type	Pipeline	None
Length in miles	10	--
Capacity, in second-feet	4	--
Inlet elevation, in feet	1,800	--
Discharge elevation, in feet	1,550	--

Estimated Costs. A summary of the estimates of costs of the various features of the two sizes of dam and reservoir at the Coulterville site, as well as the proposed pipeline to Piney Creek, is shown in Table 40. The estimated capital cost of the large size project is $738,200, including $561,000 for dam and reservoir costs and $177,200 for a pipeline six miles in length to serve the Piney Creek area. The annual cost of these features would be about $41,100 at an interest rate of four percent.

The smaller proposed Coulterville Dam and Reservoir (400 acre-feet) is estimated to have a total capital cost of $292,000, and an annual cost of $14,700.

Bean Creek Project

A project on Bean Creek was investigated because of the adaptability of the area for recreation development, and because a reservation of water rights for future water requirements has been obtained by Mariposa County. The layout of the proposed Bean Creek Project is shown on Plate 8.

As a result of water rights hearings conducted by the State Water Rights Board regarding Merced Irrigation District Applications No. 16186 and No. 16187 for an appropriation of Merced River water, Mariposa County obtained reservations from Bean Creek as follows:

> "From Bean Creek a maximum of 10,000 acre-feet of water in any consecutive ten-year period and a maximum of 1,200 acre-feet of water in any one year to be directly diverted to beneficial use and/or diverted to storage to be later applied to beneficial use."

Bean Creek is an intermittent stream, in the vicinity of Greeley Hill, tributary to the North Fork of the Merced River. The watershed is almost entirely below the snowline and derives its runoff from direct rainfall. The 5.8 square miles of drainage area above the proposed

TABLE 40

ESTIMATED CAPITAL AND ANNUAL COSTS,
COULTERVILLE PROJECT

(Based on prices prevailing in fall. 1960)

Item	Storage capacity, in acre-feet	
	2,000	400
CAPITAL COSTS		
Dam and Reservoir		
Reservoir	$ 75.000	$ 32,000
Dam	250,880	97,990
Spillway	69,000	69,000
Outlet	34,430	24,600
Unlisted items	17,690	9,610
	447.000	233,200
Contingencies	38.000	20,100
Engineering and Administration	65,000	33,200
Interest during construction (4% for 1/2 year) 2 percent	11,000	5,700
Subtotal	561,000	292,200
Conduit		
Rights of way	3,000	
Welded steel pipeline, 12-inch dia., in place	122,000	
Unlisted items, 5 percent	6,300	
	131,300	
Contingencies	19,700	
Engineering and Administration	22,700	
Interest during construction	3,500	
Subtotal	177,200	
TOTAL	$738,200	$292,200
ANNUAL COSTS		
Interest, 4 percent	$ 29,500	$ 11,700
Repayment, 0.655 percent	4,800	1,900
Replacement, dam, 0.07 percent	400	100
Replacement, pipeline 1.00 percent	1,800	--
General expense, 0.32 percent	2,400	900
Operation and maintenance, dam	400	100
Operation and maintenance, pipeline	1,800	--
	$ 41,100	$ 14,700

damsite consists of gently rolling terrain covered by a stand of young ponderosa pine above the grassland of the valley.

Planning for water conservation, soil erosion control, flood control, and other related water and soil conservation aspects in the Greeley Hill area has been accomplished by the Greeley-Coulterville Soil Conservation District. Assistance in the design of individual dams and the formulation of water conservation projects has been given by the Soil Conservation Service, U. S. Department of Agriculture. A topographic map of the Bean Creek area prepared by the Soil Conservation Service was utilized in the preparation of this report.

The Bean Creek Project would develop the recreation potential of the area, would develop a supplemental water supply for the predicted residential-farm water requirements of the area, and would provide incidental flood control and soil erosion control for the Greeley area. Two sizes of reservoirs were considered in the study of the project. The smaller reservoir would be primarily a recreation development, with some indirect benefits resulting from flood control and reduced soil erosion. The larger reservoir would provide supplemental water supplies for residential-farm uses in the Greeley area, provide for recreation development, and also provide some incidental benefits from flood control and reduced soil erosion.

Previous Investigations. The only previously published reports of water resource investigations of the portion of Mariposa County lying north of the Merced River are Department of Water Resources Bulletins No. 3 and No. 56. A brief summary of pertinent data contained in these bulletins has been presented under the proposed Coulterville Project. The investigations upon which these reports were prepared were statewide in

scope and limited in detail. The general findings in regard to the Greeley area were that the area would be in the future a water deficient area, and that supplemental water supplies should be obtained from the watershed of the Upper Tuolumne River. No justification for refinement of previous studies in regard to the proposed import from the Tuolumne River Watershed was found at this time.

Bean Creek Dam and Reservoir. The proposed Bean Creek Dam would be constructed on Bean Creek at a location about one-half mile upstream from the county road crossing at Greeley Hill. The elevation of streambed would be about 3,120 feet. The site would be approximately in the center of Section 19, Township 2 South, Range 19 East, MDB&M.

Topographic mapping of the proposed Bean Creek Dam and Reservoir site was obtained from the Soil Conservation Service. The mapping was done by photogrammetric methods to a scale of 1 inch equals 100 feet, with a contour interval of 10 feet.

The design of the dam was based on the results of a reconnaissance-type surface geological investigation made by the Department during the investigation. The site was not drilled to confirm the estimates of subsurface conditions. The bedrock in the vicinity was estimated to consist chiefly of Calaveras schists. At the dam site, the material is moderately hard and platey with vertical cleavage running perpendicular to the axis of the dam. The material would take a moderate to heavy amount of grout. The foundation material would appear to be questionable for the construction of the larger dam as proposed. A considerable amount of further geological investigation would be required to confirm this site as being acceptable.

The type of dam proposed for the Bean Creek Project would be a fill type with a gradation from an upstream impervious section to a downstream pervious section. The impervious material could be obtained near the surface of the ground within the proposed reservoir area, and the pervious materials could be obtained by deeper excavations. Pipe drains should probably be installed just downstream from the impervious section to avoid possible trouble resulting from a breaking down of the pervious materials. The upstream face of the dam would be protected from erosion by a layer of gunite on the portions which could be affected by wave action.

Stripping of foundation materials from the upper portion of the abutments should be about four to five feet in depth. From the lower portion of the abutments about eight to ten feet of overburden and weathered rock should probably be stripped. Stripping of the foundation in the channel section of the dam would probably consist of approximately five feet of stream gravels, plus an additional five feet of weathered rock beneath the impervious zone of the dam.

No records of streamflow are available for Bean Creek, and it was therefore necessary to make estimates of historical runoff. Estimates of runoff for Bean Creek at the proposed damsite were made by correlation with the estimated runoff of Maxwell Creek above the proposed Coulterville Dam. These estimates of runoff are shown in Table 41, "Estimated Runoff of Bean Creek at Bean Creek Damsite".

An overpour spillway would be located through the right abutment of the damsite. The peak runoff from the proposed reservoir drainage area during a flood predicted to occur once in a thousand years is estimated to be about 5,000 second-feet. The surcharge storage capacity in the proposed

TABLE 41

ESTIMATED RUNOFF OF BEAN CREEK AT BEAN CREEK DAMSITE
(In acre-feet)

Water Year	Annual Runoff	Water Year	Annual Runoff
1921-22	5,700	1928-29	1,300
-23	3,600	-30	1,900
-24	400	-31	800
-25	4,700	-32	5,200
-26	1,700	-33	900
-27	5,000	-34	700
-28	3,100	-35	5,800

reservoir would have a considerable effect upon the requirement for spillway discharge. The 25-foot weir estimated for this report would have an elevation 10 feet lower than the dam crest, and would have a capacity of 2,000 second-feet with a residual freeboard of 2 feet. The spillway chute would be concrete lined and would terminate in a stilling basin at the elevation of streambed.

In the case of the larger proposed reservoir which would provide a supplemental water supply, a pipeline and water treatment and storage facilities would be additional requirements.

There are several uncertainties in regard to the construction of a dam at the proposed Bean Creek damsite which would require further investigations before a final design could be made. Because of the poor quality of the foundation rock, the design of the outlet works might have to be made to accommodate possible conditions of differential settlement. Because of the questionable competence of the proposed pervious material in the dam, it might be found necessary to provide chimney drains along the contact downstream from the impervious section of the dam. The

proposed slopes of the fill material of the dam embankment might be changed after a testing of the materials.

It is believed, however, that the overall design of this dam for purposes of making estimates of cost is conservative, and that changes required to overcome any of the deficiencies mentioned above would not appreciably increase the estimated cost of the proposed dam and reservoir.

Accomplishments. The proposed Bean Creek Project would provide an excellent recreation reservoir with either size dam proposed in this report. The larger size structure would provide for the development of supplemental water supplies for residential-farm use in the Greeley area. Either of the developments would have some incidental benefits such as flood control and soil erosion control.

The reservoir setting for the proposed Bean Creek Project is typical of the more attractive portions of the Sierra National Forest. Bean Creek is in an upland valley, and the lands that surround the proposed reservoir would be of gentle slope. The site is well suited for camping, could be developed for such use rather easily, and would accommodate many people. The developed site would thus help to meet the present need for additional camping facilities in Mariposa County and in the State. It has been estimated that during the year 1958 there was a statewide deficiency of 10,000 camping units. The number of visitor-days of use which could be expected from the proposed Bean Creek Project was not evaluated; however, it is believed that the Bean Creek Project would rank second in terms of visitor-days of use at the four proposed local projects discussed in this report. The new divided highway which is being constructed through the

vicinity of Burch Meadows into Yosemite Park is only a few miles to the north of this site. The increased use of this entrance to Yosemite National Park would greatly increase the demand for camping and other recreation facilities of the proposed project.

The 1,300 acre-foot Bean Creek Reservoir would provide an estimated safe annual water supply of 600 acre-feet. The predicted future utilization of this water supply would be predominantly for residential-farm type developments. The probable future demand for supplemental water supplies for urban and municipal uses in the Greeley area has been estimated to be very small. The general features and accomplishments of two possible sizes of reservoir on Bean Creek are listed in Table 42.

The depths of water, the elevations of water surface, the water surface areas, and the storage capacities of Bean Creek Reservoir for various stages are shown in Table 43. The proposed operation of that reservoir is shown in Table 44, "Annual Summary of Yield Study, Bean Creek Reservoir".

Estimated Costs. Cost estimates are presented for two sizes of dam and reservoir at the Bean Creek site. Estimates of cost for distribution, storage, and water treatment facilities are not presented because the location, length, and capacity for such facilities should be based upon a great deal of additional information which is not now available. A summary of the estimated costs of the dams and reservoirs is shown in Table 45, "Estimated Capital and Annual Costs, Bean Creek Project".

TABLE 42

GENERAL FEATURES AND ACCOMPLISHMENTS,
BEAN CREEK PROJECT

Item	Reservoir storage capacity, in acre-feet	
	1,300	590
Bean Creek Dam		
Type	Earthfill	Earthfill
Crest elevation, in feet	3,165	3,159
Crest length, in feet	880	680
Crest width, in feet	20	20
Height of spillway above streambed, in feet	35	29
Side slopes, upstream	5:1	5:1
Side slopes, downstream	3:1	3:1
Freeboard above spillway lip, in feet	10	10
Elevation of streambed, in feet	3,120	3,120
Volume of fill, in cubic yards	167,000	114,000
Bean Creek Reservoir		
Surface area, at spillway lip, in acres	138	78
Surface area with maximum drawdown, in acres	54	54
Drainage area, in square miles	4.9	4.9
Yield, in acre-feet	600	0
Type of spillway	Overpour	Overpour
Spillway discharge capacity, in second feet	2,000	2,000
Type of outlet	Pipe beneath dam	

TABLE 43

AREAS AND CAPACITIES OF BEAN CREEK RESERVOIR

Depth of water at dam, in feet	Water surface elevation, U.S.G.S. datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	3,120	0	0
10	3,130	5	26
20	3,140	25	133
25	3,145	47	283
30	3,150	88	698
35	3,155	138	1,298
40	3,160	188	2,078

TABLE 44

ANNUAL SUMMARY OF YIELD STUDY,
BEAN CREEK RESERVOIR[1/]

(In acre-feet)

Water year	Inflow	Evaporation	Yield	Spill	Storage September 30
1921-22	5,700	460	600	3,680	960
23	3,600	460	600	2,740	760
24	400	360	600	0	200
25	4,700	460	600	2,980	860
1925-26	1,700	460	600	940	560
27	5,000	460	600	3,640	860
28	3,100	460	600	2,240	660
29	1,300	460	600	440	460
30	1,900	460	600	740	560
1930-31	800	460	600	0	300
32	5,200	460	600	3,580	860
33	900	460	600	240	460
34	700	310	600	0	250
35	5,800	440	600	4,050	960
TOTAL	40,800	6,170	8,400	25,270	
Average	2,900	440	600	1,800	

1/ 1,300 acre-foot capacity.

TABLE 45

ESTIMATED CAPITAL AND ANNUAL COSTS,
BEAN CREEK PROJECT
(Based on prices prevailing in the fall of 1960)

Item	Storage capacity, in acre-feet: 1300	590
CAPITAL COSTS		
Reservoir	$ 68,800	$ 55,200
Dam	172,840	127,650
Spillway	42,510	42,510
Outlet works	34,350	31,390
Unlisted items, 5 percent	12,500	10,750
Subtotal	$ 331,000	$ 267,500
Contingencies, 15 percent	39,300	31,800
Engineering and administration 15 percent	45,200	36,600
Interest during construction	8,000	6,000
TOTAL	$ 423,500	$ 341,900
ANNUAL COSTS		
Interest, 4 percent	$ 16,900	$ 13,700
Repayment, 0.655 percent	2,800	2,200
Replacement, 0.07 percent	300	200
Operation and maintenance	300	100
General expense, 0.32 percent	1,400	1,100
TOTAL	$ 21,700	$ 17,300

Summary. It is estimated that a dam and reservoir at the proposed Bean Creek site containing 590 acre-feet of storage would cost $341,900. The corresponding annual cost of this development based on an interest rate of four percent would be $17,300. This proposed reservoir would provide an excellent setting for camping facilities which are needed in this region of the State, and the project could probably be justified as a recreation project similar to the proposed Agua Fria Project.

A 1,300-acre-foot dam and reservoir at the Bean Creek site would have a capital cost of $423,500 and an annual cost of $21,700 based

on an interest rate of four percent. This larger size reservoir would provide a safe annual yield of 600 acre-feet for residential-farm type use as well as providing recreation potential.

Planning for Areawide Development of the Merced River

The Merced Irrigation District has started construction of its Merced River development which consists of the development of New Exchequer Dam and Reservoir, to provide 1,000,000 acre-feet of storage capacity, and McSwain Afterbay Dam and Reservoir, to provide 8,750 acre-feet of storage. The district has also made a feasibility study of two other conservation sites; namely, Snelling Dam and Reservoir which would provide 190,000 acre-feet of storage capacity, and Upper Bagby Dam and Reservoir which would provide 400,000 acre-feet of storage. Future development of additional storage in excess of 1,000,000 acre-feet at New Exchequer Reservoir may be more economical than the development elsewhere.

Studies indicate that many of the advantages of the development of the proposed Upper Bagby Dam could be realized from a development of the South Fork of the Merced River. The South Fork development would have the added advantage of providing for the future water requirements of Mariposa County.

Previous investigations show the South Fork of the Merced River to be the only source of sufficient supplemental water for that portion of Mariposa County lying south of the main stem of the Merced River. Preliminary studies indicate the highest and most economical degree of development for the Merced River from an areawide point of view would be attained by a combination of two elements: (1) development of the largest amount of storage practicable in the vicinity of New Exchequer Dam and Reservoir and (2) development of the South Fork of the Merced River.

These two developments should be integrated in a manner which would maximize the net benefits due to conservation, flood control, hydroelectric power, recreation, and fish and wildlife functions of the combination.

The development of the South Fork of the Merced River has been studied to a considerable extent during the present investigation. Many alternative developments have been studied. One which would terminate with a hydroelectric powerplant near the vicinity of the town of Bagby has been selected for presentation because it would best accomplish the intended purposes of providing a supplemental water supply for Mariposa County and develop the potential of the Merced River. The proposed powerplant would be located at an elevation of 960 feet, which would allow an additional 1,000,000 acre-feet of storage capacity to be developed in the future by increasing storage in New Exchequer Reservoir.

The advantageous locations for possible storage development of the runoff of the South Fork of the Merced River appear to be either on the South Fork below Bishop Creek or as offstream storage on Magoon Creek in the upper Chowchilla River watershed, or as a combination of these. A diversion tunnel approximately eight miles long would be required for the diversion from the South Fork to the Magoon Creek and Lush Meadows area. The cost of storage on the South Fork has been found to be greater than on Magoon Creek; however, the advantage of increased yield from storage on the South Fork appears to make storage there just as economical as storage on Magoon Creek. Storage on the South Fork is also advantageous for the reason that releases could be made for the enhancement of the fisheries below the point of diversion. In the plan which is presented in this report, storage would be provided by a dam located at a point about

Maggan Creek and Lush Meadows area with apple orchards in background

one mile downstream from the confluence of Bishop Creek and the South Fork of the Merced River. A storage capacity of 70,000 acre-feet was chosen because it would develop the lowest cost hydroelectric energy while providing for the future water needs of Mariposa County.

Proposed South Fork Merced River Project

The proposed South Fork Merced River Project would consist of (1) a large rockfill dam on the South Fork of the Merced River; (2) a long conduit including tunnels, canals, flumes, and siphons leading to a forebay reservoir on the north side of Mount Bullion at Lyon Gulch; and (3) a power conduit and powerplant in the vicinity of the town of Bagby. The layout of the proposed project is shown on Plate 4, "Plans for Development". The separate units of the proposed project with the general features of each are presented in Table 46, "General Features of Proposed South Fork Merced River Project".

The proposed South Fork Merced River Diversion Dam site is underlain by a complex assemblage of schist and quartzite. The schist and quartzite appear to have been plastically deformed, welded, and metamorphosed. The original rocks were recrystallized to form fine-grained, highly siliceous rocks which are very hard and somewhat brittle. This rock should provide a suitable foundation for a fill or concrete gravity dam. Original bedding in the schist is discernible and represents a plane of weakness. The bedding strikes North 40° West, and has a vertical dip. The reservoir area is also underlain by schist, quartzite, and granitic rock.

The type of dam proposed for the South Fork Merced River Diversion Dam is rockfill with impervious earthen central core. Impervious

TABLE 46

GENERAL FEATURES OF PROPOSED
SOUTH FORK MERCED RIVER PROJECT

South Fork Merced River Diversion Dam

Type	rockfill with central earthen core
Crest elevation, USGS datum, in feet	3,520
Crest length, in feet	1,180
Crest width, in feet	30
Height, spillway lip above streambed, in feet	470
Freeboard above spillway lip, in feet	12
Side slopes, upstream	2 to 1
downstream	2 to 1
Side slopes of central core, upstream	0.5 to 1
downstream	0.5 to 1
Volume of total fill, in cubic yards	8,500,000
Type of spillway	ungated, ogee weir and unlined open cut

South Fork Merced River Diversion Reservoir

Storage capacity at spillway lip, in acre-feet	70,000
Surface area at spillway lip, in acres	494
Drainage area, in square miles	178
Yield of dependable water by diversion, annually, in acre-feet	75,180
Yield of water by diversion, average annual, in acre-feet	109,000
Release to stream for fisheries, in second-feet	15

South Fork Merced-Lyon Gulch Conduit

Tunnel, 7-foot lined and 9-foot unlined, length in feet	45,850
Siphon, Devil's Gulch, 6-foot pipe, length in feet	400
Canals, concrete-lined, length in feet	101,000
Siphon, Yosemite Highway, 6-foot pipe, length in feet	3,900
Flumes, 6-foot concrete bench, length in feet	9,000
Capacity of conduit, in second-feet	313
Siphon, Triangle Road, 6-foot pipe, length in feet	2,000

(Continued)

TABLE 46 (Continued)

GENERAL FEATURES OF PROPOSED
SOUTH FORK MERCED RIVER PROJECT

Lyon Gulch Forebay Dam	
Type	rockfill with central earthen core
Crest elevation, USGS datum, in feet	3,035
Crest length, in feet	900
Crest width, in feet	20
Height, spillway lip above streambed, in feet	115
Freeboard above spillway lip, in feet	10
Side slopes, upstream	1.75 to 1
downstream	1.75 to 1
Side slopes, of central core, upstream	0.5 to 1
downstream	0.5 to 1
Volume of fill, total, in cubic yards	782,000
Type of spillway	ungated weir and unlined open cut
Lyon Gulch Forebay Reservoir	
Storage capacity at spillway lip, in acre-feet	3,250
Storage capacity at minimum pool, in acre-feet	2,200
Water surface elevation at spillway lip, USGS datum, in feet	3,025
Water surface elevation at minimum pool, in feet	3,012
Water surface area at spillway lip, in acres	75
Drainage area, in square miles	2
Bagby Power Conduit	
Capacity, in second-feet	500
Canals, concrete-lined, length in feet	16,000
Flumes, concrete bench, length in feet	5,000
Intake to pressure conduit, water surface elevation, in feet	3,000
Maximum drawdown of water surface at intake, in feet	10
Tunnel, 7-foot lined, length in feet	2,000
Penstock, 6.5 to 5.5-foot diameter, length in feet	4,300
Bagby Powerplant	
Minimum water surface elevation at intake, USGS datum, in feet	2,990
Elevation of jets and impulse wheel, in feet	960
Minimum gross static head, in feet	2,030
Loss of effective head with 500 second-foot discharge, in feet	80
Loss of effective head with 140 second-foot discharge, in feet	7
Installed capacity of powerplant, in kilowatts	70,000

earthen material is lacking near the damsite but could probably be obtained in the Granite Creek area, three miles to the southwest, and the Rush Creek area, seven miles to the south. In both areas impervious material is a decomposed granitic rock having the nature of silty sand. Pervious rockfill construction materials could be quarried near the site, either in schists and quartzite or in granitic rock. The materials excavated from the proposed spillway could probably be incorporated into the proposed dam structure.

The proposed diversion tunnel from the South Fork of the Merced River to the vicinity of Darrah in the upper Chowchilla River watershed would be about eight miles in total length. It would daylight enroute in Devil's Gulch at the approximate half-way point. The tunnel would be at least 1,000 feet beneath the surface of the mountain terrain throughout most of the route. Maximum cover would be approximabely 3,500 feet in the vicinity of Signal Peak. Inflowing water is anticipated in places; however, the rate of inflow is difficult to estimate. The tunnel as proposed would be 7-foot concrete lined for an estimated 30 percent of the total length, and 9-foot unlined in the remaining center portions. Much additional geological investigation would be required before the estimate of cost for this proposed tunnel could be considered to be reliable.

The proposed conduit from the vicinity of the termination of the tunnel near Darrah to a proposed forebay reservoir at Lyon Gulch would be about 116,300 feet in total length. It would consist of about 101,000 lineal feet of concrete lined canal, 9,000 lineal feet of concrete bench flume, and 6,300 lineal feet of reinforced concrete pipeline. The conduit would cross the Yosemite Highway at the summit about four miles north of the town of Mariposa. It would have a capacity of 313 second-feet, and

the location of the conduit would be ideal for future water service to areas of Mariposa County lying south of the main stem of the Merced River.

The conduit alignment follows an area underlain by metavolcanic, granitic, and metasedimentary rocks. Much of the terrain is rolling hills covered by moderate to thick brush growing on a variable depth, poorly developed soil cover. Excavation for an open ditch section would be classified as mostly common. The frequency of the occurrences of bedrock is greater in areas of irregular topography. These areas will require pipe or flume sections and include the alignment particularly near Darrah-Buckingham Mountain, Triangle Mountain, and other local random areas.

The proposed Lyon Gulch Forebay Dam and Reservoir area is underlain by metavolcanic rocks. The bedrock is mantled by an undetermined depth of overburden composed of weathered rock. The metavolcanic rocks are generally dark green in color, very hard, and highly fractured near the surface; and weathering is generally irregular. These rocks appear to be adequate for the foundation of a fill or concrete gravity dam of a maximum height of 150 feet. A moderate amount of stripping beneath the dam would be required. The spillway could be situated above either abutment, and the metavolcanic rocks should provide a sound foundation for an unlined spillway.

The type of dam proposed for the Lyon Gulch Forebay is rockfill with impervious earthen central core. The dam would be 115 feet in height above streambed. The material for the rockfill probably could be obtained at the damsite, and the material excavated from the spillway probably could be incorporated into the dam structure. Impervious earthen material probably could be obtained from within the reservoir area. The impervious material

appears to be a residual clayey sand, and it might be possible to modify the type of dam to be rockfill with impervious earthen membrane.

The proposed Lyon Gulch Forebay Reservoir would have a capacity of 3,250 acre-feet. It would serve to reregulate the diversion from the South Fork to a schedule for the production of hydroelectric energy at the proposed Bagby Powerplant. The reservoir site appears to be suitable for recreation development, but studies have not been made of the recreation, fish and wildlife aspects. The capacity of the proposed Bagby Power Conduit leading from Lyon Gulch Forebay would be 500 second-feet.

The proposed Bagby Power Conduit would consist of 16,000 lineal feet of concrete lined canal, 5,000 lineal feet of concrete bench flume, an intake structure for the pressure section of conduit, 2,000 lineal feet of concrete lined pressure tunnel, and 4,300 lineal feet of steel penstock. The proposed canal would traverse the northeast slope of Bullion Mountain, and would be interspersed with sections of bench flume as required. The metavolcanics in the area have only shallow depths of soil mantle and are cut by numerous V-shaped gullies. It is estimated that 70 percent of the excavation for the proposed canal would be in rock. The proposed pressure tunnel and penstock are also in the region of metavolcanics, and the construction of the upper section of penstock would probably require excavation to a depth of about 15 feet.

The proposed Bagby Powerplant would be located on the south side of the main stem of the Merced River about two and one-half miles upstream from the present Mother Lode Highway bridge at Bagby.

Operation of Proposed South Fork Merced River Project

Preliminary operations studies were made for various sizes of

reservoirs and conduits for possible inclusion in the proposed South Fork Merced River Project. Because the project as presented is not the only development which should be considered in planning the future development of the South Fork Merced River, pertinent data gathered during the investigation relative to various amounts of storage at the site of the South Fork Merced River Diversion Reservoir are presented in Table 47, "Accomplishments of Storage on South Fork Merced River". A final operation study was made after the selection of project features as previously described.

The monthly operation of the proposed project during a critically dry cycle of long duration, such as occurred from June 1921 until September 1937, is shown in Table 52, "Proposed Operation of South Fork Merced River Diversion Reservoir and Bagby Powerplant" (this multipage table is located at the end of the chapter). The monthly operation study shows the proposed operation of South Fork Merced River Diversion Reservoir, including inflows, fish releases and spills, diversions to Bagby Powerplant, storage at end of month, and production of hydroelectric energy.

In the operation of the proposed project the 194,000 acre-feet of average annual runoff at the site of the South Fork Merced River Diversion Reservoir would be developed as follows: 6,000 acre-feet would be released for the enhancement of fish, wildlife, and recreation; 140,000 acre-feet would be utilized for the production of hydroelectric energy; and 48,000 acre-feet would occur as uncontrolled spills. The irrigation, power, flood control and recreation aspects of the Merced River Development of the Merced Irrigation District would be enhanced by the regulatory effect of the proposed project. A future demand for supplemental water supplies in Mariposa County would be met by diversion from the South Fork

TABLE 47

ACCOMPLISHMENTS OF STORAGE ON SOUTH FORK MERCED RIVER
(In acre-feet, except where indicated otherwise)

Storage capacity	5,000	10,000	15,000	20,000	25,000	30,000	40,000	50,000	60,000	70,000
Critical dry period 1/	1	2	3	3	3	4	5	5	5	5
Inflow	120	2,220	5,000	5,000	5,000	7,420	60,960	60,960	60,960	60,960
Available water, gross	5,120	12,220	20,000	25,000	30,000	37,420	100,960	110,960	120,960	130,960
Evaporation	200	300	400	500	500	500	1,000	1,000	1,000	1,000
Available water, net	4,920	11,920	19,600	24,500	29,500	36,920	99,960	109,960	119,960	129,960
Fisheries, releases	2,400	3,600	4,200	4,200	4,200	4,500	9,900	9,900	9,900	9,900
Diversion	2,520	8,320	15,400	20,300	25,300	32,420	90,060	100,060	110,060	120,060
Minimum hours of powerplant operation during period 2/	1,100	1,830	2,280	2,280	2,280	2,470	5,710	5,710	5,710	5,710
Second-feet available during minimum hours	27.8	55.0	81.5	108.0	134.5	159.0	191.0	212.0	233.2	254.2
Total hours during period	2,208	3,672	5,160	5,160	5,160	5,932	13,176	13,176	13,176	13,176
Second-feet available of firm constant flow	13.8	27.4	36.1	47.6	59.4	67.3	83.0	92.0	101.2	110.3

1/ The periods denoted in this line would be as follows:
1. August 1, 1928 - November 1, 1928
2. July 1, 1928 - December 1, 1928
3. July 1, 1928 - February 1, 1929
4. July 1, 1928 - March 1, 1929
5. July 1, 1930 - January 1, 1932

2/ These minimum hours are based on an annual capacity factor of 41.5 percent.

Merced-Lyon Gulch Conduit. The possible future water use in Mariposa County is not shown as a separate heading in Table 52, but the source of water is included under the heading "Diversion to Bagby".

During the summer months of July, August, and September, 900 acre-feet would be released from the proposed South Fork Merced River Diversion Reservoir (except for one extremely dry year during a 50-year period) for the enhancement of fish. This release of new water would occur when the stream would otherwise be dry. The low temperature of the water in the reservoir during the late summer months would be very favorable for enhancement of the trout fishery.[1/]

Releases from the diversion reservoir through the diversion conduit would be made for the purpose of producing hydroelectric energy at the Bagby Powerplant in such a manner as to provide the maximum amount of dependable power in conjunction with the operation of a proposed enlarged New Exchequer Powerplant. During the five-month period from November 1 through March 31, diversions would be made from the South Fork sufficient to produce 70,000 kilowatts of dependable power, and no secondary power would be produced unless the storage in the reservoir was in excess of minimum storage requirements. Predictions of spring runoff would allow the calculated releases of water during April, May, and June in such a manner that the reservoir would be full at the end of June. During the four-month period from July 1 through October 30 sufficient diversions would be made to maintain a minimum power production of 20,000 kilowatts. The criteria which were followed during this investigation for monthly

1/ Reference is made to a report entitled "Fish and Wildlife Resources of Mariposa County in Relation to Proposed Water Development Projects", Department of Fish and Game, State of California, June 1960 (material from this report is reproduced as Appendix C of this Bulletin).

releases from the South Fork Merced River Diversion Reservoir are shown in Table 48, "Criteria for Operation of Proposed South Fork Merced River Diversion Reservoir".

An analysis of the operation study indicates that a firm water supply of about 24,000 acre-feet for the Mariposa area could be developed by directing project water away from the proposed Bagby Powerplant during other than dry years. Supplemental storage in small reservoirs in Mariposa County could provide water during a dry water year such as 1930-31. Table 49, "Possible Development of Water Supplies for Mariposa Area From Proposed South Fork Merced River Project", illustrates this proposal. The reason for reserving 75,500 acre-feet was that this amount is necessary for production of dependable power during a dry year such as 1930-31, and further encroachment upon the water supply of the project would be relatively more detrimental to power revenues. Storage space could be provided in proposed local projects and in existing and future small reservoirs.

Estimated Costs of Proposed South Fork Merced River Project

The estimated total capital cost for construction of all features of the Proposed South Fork Merced River Project would be about $49,000,000. The corresponding estimate of total annual cost based on an interest rate of four percent and a repayment period of 50 years would be about $2,746,700. These estimates of costs have been based on prices prevailing in the fall of 1960.

The estimated capital costs of the individual features of the proposed project are shown in Table 50, "Reconnaissance Estimates of Capital Costs of Proposed South Fork Merced River Project". These estimated costs

TABLE 48

CRITERIA FOR OPERATION OF PROPOSED SOUTH FORK MERCED RIVER DIVERSION RESERVOIR
(In acre-feet)

No.*	Month	Dependable kilowatts	Minimum** release	Maximum release	Minimum storage end of month	Scheduled*** release
10	October	20,000	3,450 1/	19,200	55,000	$1.0(I_{10}+S_9-55,000)$
11	November	70,000	11,280 2/	18,600	54,000	$1.0(I_{11}+S_{10}-54,000)$
12	December	70,000	9,650 2/	19,200	45,000	$1.0(I_{12}+S_{11}-45,000)$
1	January	70,000	8,450 2/	19,200	37,000	$1.0(I_1+S_{12}-37,000)$
2	February	70,000	7,650 2/	17,300	30,000	$1.0(I_2+S_1-30,000)$
3	March	70,000	9,650 2/	19,200	25,000	$1.0(I_3+S_2-25,000)$
4	April	20,000	3,100 3/	18,600	variable	$0.29(I_4+I_5+I_6+S_3-70,000)$
5	May	20,000	3,450 4/	19,200	variable	$0.45(I_5+I_6+S_4-70,000)$
6	June	20,000	4,140 5/	18,600	variable	$1.0(I_6+S_5-70,000)$
7	July	20,000	5,170 1/	19,200	65,000	$1.0(I_7+S_6-65,000)$
8	August	20,000	5,170 1/	19,200	60,000	$1.0(I_8+S_7-60,000)$
9	September	20,000	4,020 1/	18,600	56,000	$1.0(I_9+S_8-56,000)$

* Months are numbered for reference.
** Based on capacity factor of 41.5 percent.
*** Note: I = inflow; S = storage; accompanying number denotes month of reference.

1/ Release the required minimum plus any additional amount up to that scheduled.

2/ Assumed mandatory requirement to produce 70,000 kilowatts of dependable power during the months of November, December, January, February, and March of each year.

3/ Release for power is based on forecast of spring runoff. Release 29 percent of all supply which would be in excess of the storage capacity at the end of June. That is, R = 0.29 (present storage plus inflow for April, May, and June minus the capacity of the reservoir). This value is made to be not less than the minimum required release of 3,100 acre-feet, nor more than the conduit capacity of 18,600 acre-feet.

(Continued)

TABLE 48 (Continued)

CRITERIA FOR OPERATION OF PROPOSED SOUTH FORK MERCED RIVER DIVERSION RESERVOIR

(Footnotes continued)

4/ Release for power is based on forecast of spring runoff. Release 45 percent of all supply which would be in excess of the storage capacity at the end of June. That is, R = 0.45 (present storage at beginning of month plus inflow for May and June minus the capacity of the reservoir). This value is made to be not less than the minimum required release of 3,500 acre-feet nor more than the conduit capacity of 19,200 acre-feet.

5/ Release for power all water which would otherwise spill during this month. This value is made to be not less than the minimum required release of 4,100 acre-feet, nor more than 18,600 acre-feet.

TABLE 49

POSSIBLE DEVELOPMENT OF WATER SUPPLIES FOR MARIPOSA AREA
FROM PROPOSED SOUTH FORK MERCED RIVER PROJECT
(In acre-feet)

Runoff year	Amount of diversion from proposed project 1/	Change in storage of local reservoirs	Storage required in local reservoirs	Firm Water supply for Mariposa area
1922-23	34,000	--	60,000	34,000
-24	5,900	-28,100	31,900	34,000
-25	54,600	+20,600	52,500	34,000
-26	37,400	+ 3,400	55,900	34,000
-27	38,100	+ 4,100	60,000	34,000
-28	34,000	0	60,000	34,000
-29	13,000	-21,000	39,000	34,000
-30	9,500	-14,500	24,500	24,000
-31	0	-24,000	500	24,000
-32	50,300	+26,300	26,800	24,000
-33	26,000	+ 2,000	28,800	24,000
-34	9,600	-14,400	14,400	24,000
-35	59,400	+25,400	39,800	34,000
-36	54,200	+20,000	60,000	34,000
-37	34,000	0	60,000	34,000

1/ Based on reserving 75,500 acre-feet of dependable water supply for production of power at proposed Bagby Power Plant each year.

TABLE 50

RECONNAISSANCE ESTIMATES OF CAPITAL COSTS OF PROPOSED SOUTH FORK MERCED RIVER PROJECT
(Based on prices prevailing in the fall of 1960)

Item No.	Item	Unit	Quantity	Unit price*	Cost
1	South Fork Merced Diversion Dam and Reservoir	cu yd	8,500,000	$ 2.53	$ 21,500,000
2	South Fork Merced Diversion Tunnel: 30 percent is 7-foot lined horseshoe; 70 percent is 9-foot unlined horseshoe	lin ft	45,000	210.00	9,566,800
3	Access Road to Devil's Gulch	mile	10	20,400.00	204,000
4	Siphon across Devil's Gulch, 6-foot R.C.P.	lin ft	500	83.00	41,500
5	Canal, 312 second-feet, Snow Creek to Mariposa Creek gap, concrete-lined	lin ft	80,000	21.00	1,680,000
6	Buckingham Mountain Flume	lin ft	9,000	82.00	738,000
7	Siphon, Acorn Lodge road crossing, 5.5-foot R.C.P.	lin ft	2,000	68.00	136,000
8	Siphon, Yosemite Highway crossing, 5.5-foot R.C.P.	lin ft	3,900	68.00	265,000
9	Canal, 312 second-feet, Mariposa Creek gap to Lyon Gulch, concrete-lined	lin ft	21,000	33.00	692,500
10	Lyon Gulch Forebay Dam and Reservoir	cu yd	782,000	2.00	1,564,000
11	Lyon Gulch outlet works	lump sum			100,000
12	Canal, 500 second-feet, Lyon Gulch to power intake, concrete-lined	lin ft	16,000	50.00	800,000
13	Fremont Peak Flume	lin ft	5,000	116.00	580,000
14	Drunken Gulch Forebay, power intake	lump sum			500,000
15	Tunnel, power conduit, 7-foot lined	lin ft	2,000	268.00	536,000
16	Surge shaft, power conduit, 7-foot lined	lin ft	300	500.00	150,000
17	Access road to Drunken Gulch	mile	3	10,000.00	30,000
18	Penstock to Bagby Powerplant	lb	4,838,000	0.65	3,120,000
19	Bagby Powerplant	kw	70,000	82.90	5,800,000
20	Power Transmission Facilities	lump sum			1,000,000
	TOTAL CAPITAL COST				$49,003,800

*Unit price includes 30 percent allowance for contingencies, plus interest during construction at 4 percent.

include a total allowance of 30 percent to cover contingencies, engineering and administration. An additional allowance has been included for interest during construction. These reconnaissance-type estimates of cost are based on geological information gathered from surface inspections.

The estimated annual costs of the individual features of the proposed project are shown on Table 51, "Reconnaissance Estimates of Annual Costs of Proposed South Fork Merced River Project". These estimates of annual cost are based on the premise that all items of cost would be repaid at an interest rate of four percent over a repayment period of 50 years.

Estimated Benefits of Proposed South Fork Merced River Project

Primary benefits from the proposed South Fork Merced River Project would be derived mostly from hydroelectric energy produced at the Bagby Powerplant and water supplies delivered to Mariposa County. The Agua Fria Project, proposed as a local project in a preceding section of this report, would probably serve the more pressing water needs of the town of Mariposa and surrounding environs until about the 1990-2000 year period. For this reason it appears that water supply benefits attributable to the proposed South Fork Merced River Project would be very limited until after the year 1990.

Power Benefits. The proposed Bagby Powerplant would produce 240 million kilowatt-hours of average annual energy. It would provide a firm generating capacity of 70,000 kilowatts during the months of November, December, January, February, and March -- months during which the new Exchequer generating facilities would probably not be used at full capacity. During the other seven months of the year Bagby could produce 20,000 kilowatts of dependable power while the output at Exchequer would be

TABLE 51

RECONNAISSANCE ESTIMATES OF ANNUAL COSTS OF PROPOSED SOUTH FORK MERCED RIVER PROJECT
(Based on interest rate of 4 percent)

Item No.	Description	Capital costs	Annual costs: Capital recovery	Replacement	Operation, maintenance, and insurance	Total
I.	Dams and Reservoirs					
	South Fork	$21,500,000	$1,000,800	$15,100	$ 9,500	$1,025,400
	Lyon Gulch Forebay	1,564,000	72,800	1,100	400	74,300
	Drunken Gulch Forebay	500,000	23,300	400	200	23,900
	Subtotals	$23,564,000	$1,096,900	$16,600	$ 10,100	$1,123,600
II.	Powerplants					
	Bagby	$ 5,800,000	$ 270,000	$24,200	$ 177,500	$ 471,700
III.	Transmission Facilities	$ 1,000,000	$ 46,500	$18,000	$ 39,200	$ 103,700
IV.	Penstocks					
	Bagby	$ 3,120,000	$ 145,200	$31,200	$ 2,000	$ 178,400
V.	Tunnels					
	South Fork Diversion	$ 9,566,800	$ 445,300	$19,100	$ 47,800	$ 512,200
	Drunken Gulch	536,000	25,000	1,100	2,700	28,800
	Bagby Surge Shaft	150,000	7,000	300	800	8,100
	Subtotals	$10,252,800	$ 477,300	$20,500	$ 51,300	$ 549,100
VI.	Pipelines and Siphons					
	Devil's Gulch Siphon	$ 41,500	$ 1,900	$ 400	$ 300	$ 2,600
	Acorn Lodge Siphon	136,000	6,300	1,400	700	8,400
	Yosemite Highway Siphon	265,000	12,300	2,700	1,400	16,400
	Subtotals	$ 442,500	$ 20,500	$ 4,500	$ 2,400	$ 27,400

TABLE 51 (Continued)

RECONNAISSANCE ESTIMATES OF ANNUAL COSTS OF PROPOSED SOUTH FORK MERCED RIVER PROJECT
(Based on interest rate of 4 percent)

Item No.	Description	Capital costs	Annual costs: Capital recovery	Replacement	Operation, maintenance, and insurance	Total
VII.	Canals					
	Snow Creek to Mariposa Creek gap	$1,680,000	$ 78,200	$ 3,400	$16,800	$ 98,400
	Mariposa Creek gap to Lyon Gulch	692,500	32,000	1,400	6,900	40,500
	Lyon Gulch to power intake	800,000	37,200	1,600	8,000	46,800
	Subtotals	$3,172,500	$ 147,400	$ 6,400	$31,700	$ 185,500
VIII.	Flumes					
	Buckingham Mountain	$ 738,000	$ 34,400	$ 7,400	$ 7,400	$ 49,200
	Fremont Peak	580,000	27,000	5,800	5,800	38,600
	Subtotals	$1,318,000	$ 61,400	$ 13,200	$13,200	$ 87,800
IX.	Outlet Works					
	Lyon Gulch	$ 100,000	$ 4,700	$ 100	$ 1,000	$ 5,800
X.	Access Roads					
	Devil's Gulch	$ 204,000	$ 9,500	$ 400	$ 2,000	$ 11,900
	Drunken Gulch	30,000	1,400	100	300	1,800
	Subtotals	$ 234,000	$ 10,900	$ 500	$ 2,300	$ 13,700
	TOTALS	$49,003,800	$2,280,800	$135,200	$330,700	$2,746,700

increased as irrigation demands required. By integrated operation of Bagby and Exchequer power facilities it would appear that the district could market a larger block of dependable power without affecting irrigation schedules.

A study by the Merced Irrigation District of various degrees of development of dependable power in conjunction with various yields of irrigation water would be needed to determine the maximum benefits from a future expansion of the development of the Merced River.

Conservation Benefits. The need for water from the South Fork in Mariposa County will increase gradually as economic development and demand for water occurs in the Chowchilla, Mariposa Creek, Midpines, and Bear Creek service areas. The estimated 2020 water demands in Mariposa County could be at least partially met by local projects as previously described. Demands in excess of yields from local projects would eventually have to be supplied from waters of the Merced River.

During the repayment period for the proposed South Fork Merced River Project supplemental water would be available to Mariposa County. This supply would be obtained by reducing the amount of nondependable power generation and could be utilized for urban, residential-farm, and some agricultural purposes.

There would be more than enough water in the conduits to supply the future requirements estimated in Chapter III. It would be impractical, however, to attempt to estimate the value of such conservation benefits regarding this proposed project for the long-range future.

Other Benefits. There would be many benefits other than power and conservation which would accrue to Mariposa County and to the State of California because of construction of the proposed South Fork Merced

River Project. The release of cold water from the proposed South Fork Merced River Diversion Dam would provide fisheries benefits based on the enhanced capability for fish stocking as well as increased natural propagation of trout in the South Fork and main stem of the Merced River. There would be recreation benefits associated with the proposed reservoirs because a considerable amount of shoreline and surrounding lands would be suitable for recreation uses. No estimates have been made of the monetary valuation for these recreation types of benefits.

Economic Justification of Proposed South Fork Merced River Project

The proposed South Fork Merced River Project may not be economically justified for present-day construction. The multiple-purpose nature of the project and the suggested integration with the Merced River Development limits discussion herein to the opinion that such a project may be economically justified at some time in the not-too-distant future. A feasibility study should be made at such time as the Merced Irrigation District and Mariposa County believe to be appropriate.

TABLE 52

PROPOSED OPERATION OF SOUTH FORK MERCED RIVER DIVERSION RESERVOIR AND BAGBY POWERPLANT

Year	Month	Reservoir operation in thousands of acre-feet: Inflow	Fish release and spills	Diversion to Bagby	Storage at end of month	Hydroelectric energy in thousands of kilowatt-hours
1922	Oct.	0.5	0.6	3.5	57.4	6,000
	Nov.	3.9	0.3	11.3	49.7	19,600
	Dec.	9.7	0.3	14.1	45.0	16,800
1923	Jan.	5.7	0.3	13.4	37.0	24,550
	Feb.	5.7	0.3	12.4	30.0	23,350
	March	13.5	0.3	18.2	25.0	32,300
	April	26.4	0.3	18.6	32.5	32,300
	May	68.6	11.9	19.2	70.0	33,300
	June	44.2*	25.6	18.6	70.0	32,300
	July	19.4	0.9	18.5	70.0	32,200
	Aug.	1.2	0.9	5.2	65.1	9,000
	Sept.	2.6	0.9	4.0	62.8	7,000
TOTALS		201.4	42.6	157.0		268,700
1923	Oct.	3.7	0.6	3.5	62.4	6,000
	Nov.	1.6	0.3	11.3	52.4	19,600
	Dec.	1.1	0.3	9.7	43.5	16,800
1924	Jan.	2.6	0.3	9.8	36.0	17,050
	Feb.	5.6	0.3	11.3	30.0	19,650
	March	4.3	0.3	9.7	24.3	16,800
	April	18.6	0.3	3.1	39.5	5,400
	May	25.1	0.3	3.5	60.8	6,000
	June	0.2*	0.6	4.1	56.3	7,200
	July	0.1	0.9	5.2	50.3	9,000
	Aug.	0.0	0.9	5.2	44.2	9,000
	Sept.	0.0	0.9	4.0	39.3	7,000
TOTALS		62.9	6.0	81.4		139,500
1924	Oct.	3.8	0.6	3.5	39.0	6,000
	Nov.	6.6	0.3	11.3	34.0	19,600
	Dec.	6.0	0.3	9.7	30.0	16,800
1925	Jan.	3.7	0.3	8.5	24.9	14,700
	Feb.	11.8	0.3	7.7	28.7	13,300
	March	13.1	0.3	16.5	25.0	28,700
	April	28.1	0.3	18.6	34.2	32,300
	May	56.8	1.8	19.2	70.0	33,300
	June	35.7*	17.1	18.6	70.00	32,300
	July	8.2	0.9	7.3	70.0	12,700
	Aug.	2.4	0.9	5.2	66.3	9,000
	Sept.	0.4	0.9	4.0	61.8	7,000
TOTALS		176.6	24.0	130.1		225,700

(Continued)

TABLE 52 (Continued)

PROPOSED OPERATION OF SOUTH FORK MERCED RIVER DIVERSION RESERVOIR AND BAGBY POWERPLANT

Year	Month	Reservoir operation in thousands of acre-feet: Inflow	Fish release and spills	Diversion to Bagby	Storage at end of month	Hydroelectric energy in thousands of kilowatt-hours
1925	Oct.	2.9	0.6	3.5	60.6	6,000
	Nov.	2.7	0.3	11.3	51.7	19,600
	Dec.	4.7	0.3	11.1	45.0	19,300
1926	Jan.	1.9	0.3	9.6	37.0	16,700
	Feb.	4.8	0.3	11.5	30.0	20,000
	March	14.8	0.3	19.2	25.3	33,300
	April	40.6	0.3	12.9	52.7	22,400
	May	32.0	0.3	14.4	70.0	25,050
	June	5.6*	0.6	5.0	70.0	8,700
	July	0.7	0.9	5.2	64.6	9,000
	Aug.	0.0	0.9	5.2	58.5	9,000
	Sept.	0.0	0.9	4.0	53.6	7,000
TOTALS		110.7	6.0	112.9		196,050
1926	Oct.	0.1	0.6	3.5	49.6	6,000
	Nov.	7.4	0.3	11.3	45.4	19,600
	Dec.	6.8	0.3	9.7	42.2	16,800
1927	Jan.	5.4	0.3	10.3	37.0	17,950
	Feb.	12.8	0.3	17.3	32.2	30,100
	March	12.4	0.3	19.2	25.1	33,300
	April	28.7	0.3	18.6	34.9	32,000
	May	54.0	0.3	19.2	69.4	33,300
	June	62.7*	43.5	18.6	70.0	32,300
	July	15.0	0.9	14.1	70.0	24,400
	Aug.	1.2	0.9	5.2	65.1	9,000
	Sept.	0.1	0.9	4.0	60.3	7,000
TOTALS		206.6	48.9	151.0		261,750
1927	Oct.	3.6	0.6	3.5	59.8	6,000
	Nov.	12.8	0.3	11.3	61.0	19,600
	Dec.	3.1	0.3	18.8	45.0	32,700
1928	Jan.	4.5	0.3	12.2	37.0	21,200
	Feb.	4.5	0.3	11.2	30.0	19,500
	March	27.3	0.3	19.2	37.8	33,300
	April	21.9	0.3	18.6	40.8	32,300
	May	47.2	0.3	19.2	68.5	33,300
	June	12.0*	0.6	9.9	70.0	17,200
	July	1.1	0.9	5.2	65.0	9,000
	Aug.	0.1	0.9	5.2	59.0	9,000
	Sept.	0.0	0.9	4.0	54.1	7,000
TOTALS		138.1	6.0	138.3		240,100

(Continued)

TABLE 52 (Continued)

PROPOSED OPERATION OF SOUTH FORK MERCED RIVER DIVERSION RESERVOIR AND BAGBY POWERPLANT

Year	Month	Reservoir operation in thousands of acre-feet: Inflow	Fish release and spills	Diversion to Bagby	Storage at end of month	Hydroelectric energy in thousands of kilowatt-hours
1928	Oct.	0.0	0.6	3.5	50.0	6,000
	Nov.	1.0	0.3	11.3	39.4	19,600
	Dec.	1.5	0.3	9.7	30.9	16,800
1929	Jan.	1.3	0.3	8.5	23.4	14,700
	Feb.	2.4	0.3	7.7	17.8	13,300
	March	10.7	0.3	9.7	18.5	16,800
	April	13.8	0.3	6.9	25.1	12,000
	May	40.9	0.3	7.7	58.0	13,400
	June	21.7*	0.6	9.1	70.0	15,800
	July	2.3	0.9	5.2	66.2	9,000
	Aug.	0.1	0.9	5.2	60.2	9,000
	Sept.	0.0	0.9	4.0	55.3	7,000
TOTALS		95.7	6.0	88.5		153,400
1929	Oct.	0.0	0.6	3.5	51.2	6,000
	Nov.	0.0	0.3	11.3	39.6	19,600
	Dec.	3.6	0.3	9.7	33.2	16,800
1930	Jan.	2.5	0.3	8.5	26.9	14,700
	Feb.	5.5	0.3	7.7	24.4	13,300
	March	9.2	0.3	9.7	23.6	16,800
	April	20.9	0.3	5.8	38.4	10,100
	May	24.3	0.3	6.5	55.9	11,300
	June	22.6*	0.6	7.9	70.0	13,750
	July	2.6	0.9	5.2	66.5	9,000
	Aug.	0.2	0.9	5.2	60.6	9,000
	Sept.	0.2	0.9	4.0	55.9	7,000
TOTALS		91.6	6.0	85.0		147,350
1930	Oct.	0.7	0.6	3.5	52.5	6,000
	Nov.	1.9	0.3	11.3	42.8	19,600
	Dec.	0.8	0.3	9.7	33.6	16,800
1931	Jan.	1.8	0.3	8.5	26.6	14,700
	Feb.	2.9	0.3	7.7	21.5	13,300
	March	6.7	0.3	9.7	18.2	16,800
	April	16.9	0.3	3.1	31.7	5,400
	May	18.6	0.3	3.5	46.5	6,000
	June	2.3*	0.6	4.1	44.1	7,200
	July	0.2	0.2	5.2	38.9	9,000
	Aug.	0.0	0.0	5.2	33.7	9,000
	Sept.	0.0	0.0	4.0	29.7	7,000
TOTALS		52.8	3.5	75.5		130,800

(Continued)

TABLE 52 (Continued)

PROPOSED OPERATION OF SOUTH FORK MERCED RIVER DIVERSION RESERVOIR AND BAGBY POWERPLANT

Year	Month	Reservoir operation in thousands of acre-feet: Inflow	Fish release and spills	Diversion to Bagby	Storage at end of month	Hydroelectric energy in thousands of kilowatt-hours
1931	Oct.	0.1	0.1	3.5	26.2	6,000
	Nov.	0.9	0.3	11.3	15.5	19,600
	Dec.	3.0	0.3	9.7	8.5	16,800
1932	Jan.	4.6	0.3	8.5	4.3	14,700
	Feb.	10.0	0.3	7.7	6.3	13,300
	March	14.4	0.3	9.7	10.7	16,800
	April	24.4	0.3	18.6	16.2	32,300
	May	58.1	0.3	19.2	54.8	33,300
	June	64.8*	37.5	18.6	63.3	32,300
	July	17.4	0.9	9.8	70.0	17,050
	Aug.	0.9	0.9	5.2	64.8	9,000
	Sept.	0.1	0.9	4.0	60.0	7,000
TOTALS		198.7	42.4	125.8		218,150
1932	Oct.	0.1	0.6	3.5	56.0	6,000
	Nov.	0.2	0.3	11.3	44.6	19,600
	Dec.	0.7	0.3	9.7	35.3	16,800
1933	Jan.	1.2	0.3	8.5	27.7	14,700
	Feb.	1.9	0.3	7.7	21.6	13,300
	March	6.5	0.3	9.7	18.1	16,800
	April	20.1	0.3	11.1	26.8	19,300
	May	27.4	0.3	12.4	41.5	21,600
	June	42.3*	0.6	13.2	70.0	22,950
	July	3.9	0.9	5.2	67.8	9,000
	Aug.	0.2	0.9	5.2	61.9	9,000
	Sept.	0.1	0.9	4.0	57.1	7,000
TOTALS		104.6	6.0	101.5		176,050
1933	Oct.	0.7	0.6	3.5	53.7	6,000
	Nov.	0.6	0.3	11.3	42.7	19,600
	Dec.	4.0	0.3	9.7	36.7	16,800
1934	Jan.	4.1	0.3	8.5	32.0	14,700
	Feb.	4.8	0.3	7.7	28.8	13,300
	March	14.3	0.3	17.8	25.0	31,000
	April	19.3	0.3	3.1	40.9	5,400
	May	13.6	0.3	3.5	50.7	6,000
	June	5.7*	0.6	4.1	51.7	7,200
	July	0.4	0.9	5.2	46.0	9,000
	Aug.	0.1	0.9	5.2	40.0	9,000
	Sept.	0.2	0.9	5.5	33.8	9,450
TOTALS		67.8	6.0	85.1		147,450

(Continued)

TABLE 52 (Continued)

PROPOSED OPERATION OF SOUTH FORK MERCED RIVER DIVERSION RESERVOIR AND BAGBY POWERPLANT

Year	Month	Reservoir operation in thousands of acre-feet: Inflow	Fish release and spills	Diversion to Bagby	Storage at end of month	Hydroelectric energy in thousands of kilowatt-hours
1934	Oct.	2.0	0.6	6.3	28.9	10,950
	Nov.	8.6	0.3	11.3	25.9	19,600
	Dec.	6.9	0.3	9.7	22.8	16,800
1935	Jan.	7.5	0.3	8.5	21.5	14,700
	Feb.	9.9	0.3	7.7	23.4	13.300
	March	10.3	0.3	11.6	21.8	20,200
	April	37.1	0.3	18.6	40.0	32,300
	May	65.8	16.6	19.2	70.0	33,300
	June	75.1*	56.5	18.6	70.0	32,300
	July	15.1	0.9	14.2	70.0	24,700
	Aug.	0.7	0.9	5.2	64.6	9,000
	Sept.	0.3	0.9	4.0	60.0	7,000
TOTALS		239.3	78.2	134.9		234,150
1935	Oct.	1.6	0.6	3.5	57.5	6,000
	Nov.	2.2	0.3	11.3	48.1	19,600
	Dec.	1.6	0.3	9.7	39.7	16,800
1936	Jan.	7.5	0.3	9.9	37.0	17,200
	Feb.	11.4	0.3	17.3	30.8	30,100
	March	17.4	0.3	19.2	28.7	33,300
	April	41.0	0.3	18.6	50.8	32,300
	May	68.2	29.8	19.2	70.0	33,300
	June	50.7*	32.1	18.6	70.0	32,300
	July	10.0	0.9	9.1	70.0	15,800
	Aug.	0.5	0.9	5.2	64.4	9,000
	Sept.	0.4	0.9	4.0	59.9	7,000
TOTALS		212.5	67.0	145.6		252,700
1936	Oct.	0.7	0.6	3.5	56.5	6,000
	Nov.	0.6	0.3	11.3	45.5	19.600
	Dec.	5.6	0.3	9.7	41.1	16,800
1937	Jan.	3.0	0.3	8.5	35.3	14,700
	Feb.	20.9	0.3	17.3	38.6	30,100
	March	12.0	0.3	19.2	31.1	33,300
	April	32.0	0.3	18.6	44.2	32,300
	May	99.0	54.0	19.2	70.0	33,300
	June	60.7*	42.1	18.6	70.0	32,300
	July	6.6	0.9	5.7	70.0	9,950
	Aug.	0.4	0.9	5.2	64.3	9,000
	Sept.	0.3	0.9	4.0	59.7	7,000
TOTALS		241.8	101.2	140.8		244,350
AVERAGE ANNUAL		194.0	54.0	140.0		240,000

* -1.2 for evaporation.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The Mariposa Area Investigation has been conducted by the Department in close cooperation with the officials of Mariposa County, particularly the members of the Mariposa County Water Agency, and with the cooperation of many of the local residents. There appears to be general agreement that Mariposa County needs supplemental water supplies in the vicinities of Coulterville, Greeley Hill, Hornitos, Mariposa, and Catheys Valley. The initial objective of water resource development in Mariposa County should include the provision of supplemental water supplies for these areas.

The results of studies of this investigation are summarized in this chapter, and recommendations are made pertaining to water resource development.

Summary

Mariposa area contains approximately 1,578 square miles of territory, 381 square miles of which are within Yosemite National Park. The remaining 1,197 square miles of territory include 265 square miles lying within the watershed of the Chowchilla River, 278 square miles lying within the watersheds of the streams of the Eastern Merced County Stream Group, and 654 square miles within the watershed of the Merced River, approximately 112 square miles of which are within Madera County. The climate differs between the western and eastern portions of the Mariposa area primarily because of the effect of the high elevations of the Sierra Nevada. The general climate, and particularly that of the central and eastern portions which were studied most intensively during the investigation, can be described as having hot summers; cool, mild

winters; little precipitation during late spring, summer, and early fall; and comparatively heavy precipitation during a few winter months.

The Mariposa Area Investigation was conducted to gain information which is essential for the planning of water resource developments in Mariposa County, and also for formulating a general overall plan for development of water supplies needed within Mariposa County. The Merced Irrigation District is presently constructing a project on the Merced River, and the plan for future use of South Fork Merced River water supplies as presented in this report has been designed for integration with the Merced River Development Project.

At the present time there is a very good water resource basic data program under way which will provide data for use in future studies. This was not the case at the beginning of this investigation. During this investigation four stream gaging stations were established on tributaries of the Chowchilla River, three on streams of the Eastern Merced County Stream Group, and two on tributaries on the north side of the Merced River. Monthly records of runoff covering five or six years for most of these stations are included in Chapter II. Many local residents of Mariposa County have now maintained climatic stations for at least five years, and monthly records of precipitation for these stations are contained in Chapter II. Locations of stream gaging and climatic stations are shown on Plate 2, and the identification numbers on this plate provide a means for reference to several tables in the report which contain climatic and streamflow data.

A land classification and land use survey of Mariposa County was conducted during the investigation. The data were collected and compiled in groups showing the extent of lands of various characteristics

and uses in various sections of the county. There are about 3,500 acres of irrigable land in Mariposa County which are relatively flat, 2,000 acres of which are made up of deep, well-drained soils suited to many uses. In addition, 17,000 acres are deep and well drained but have limitations because of the slope of the terrain. Most of the remaining irrigable lands of Mariposa County were found to have marginal value and to be limited to the production of irrigated pasture because of shallow depth, rockiness, and steep topography.

Local areas within Mariposa County are water deficient. That is, water is available from precipitation and streamflow during winter months, but the summers are dry and local streams are intermittent. There are no extensive ground water basins in Mariposa County, and water supplies during summer months would be available only through storage in surface reservoirs.

The total water requirements of Mariposa County in the year 2020 have been estimated to be about 114,000 acre-feet. The requirements for areas lying north of the Merced River will be about 11,000 acre-feet, and the requirements for areas lying south of the river will be about 103,000 acre-feet.

Water supplies for lands lying north of the Merced River could be provided by a combination of small local projects and importations of water developed from the South and Middle Forks of the Tuolumne River. Coulterville Reservoir could provide 900 acre-feet, Bean Creek Reservoir 600 acre-feet, and the South Fork of the Tuolumne River the remaining 9,500 acre-feet. Studies were not made on the importation of water from the South Fork of the Tuolumne River because such a development would be so far in the future that studies at this time would be unjustified.

Water supplies for Mariposa County lands lying south of the Merced River could in the future be provided by a combination of local projects and an importation of water from the South Fork of the Merced River. Agua Fria Reservoir could provide 6,400 acre-feet, Norwegian Gulch Reservoir could provide 2,200 acre-feet, small projects within the Chowchilla River watershed could provide 2,000 acre-feet, and the South Fork of the Merced River could provide the remaining 92,400 acre-feet.

The Agua Fria Project would probably be the first local project constructed in Mariposa County. This reservoir would develop sufficient water supplies to provide for the requirements for the town of Mariposa and for the general area lying south of the town of Mariposa until about the year 2000. The Norwegian Gulch Project could serve the requirements of the Bear Valley and Hornitos areas, and projects within Chowchilla River watershed too small for consideration within this investigation could serve the requirements in the general area until the proposed South Fork Merced River Project is constructed.

Conclusions

As a result of the Mariposa Area Investigation, the following conclusions have been reached:

1. The water resources of Mariposa County are sufficient from an areawide point of view to provide future requirements. Natural runoff from small streams within many local areas is not sufficient to provide for the future potential economic growth of these local areas; however, the average annual runoff of the South Fork Merced River below Bishop Creek is greatly in excess of the estimated future water requirements for Mariposa County lands lying south

of the Merced River. An adequate supply of water can be provided by small local projects to meet the urban and residential farm requirements for Mariposa County lands lying north of the Merced River until after the year 1990.

2. Provisions of adequate water supplies within various localities of Mariposa County would encourage the economic growth of these areas. Studies indicate that the most practical means for the initial development of adequate water supplies would be through the development of local projects, some of which are suggested and outlined in this report. In the future when local projects prove to be inadequate for continued economic growth, the portion of Mariposa County lying south of the Merced River could be provided with supplemental water supplies from the South Fork Merced River. The portion of Mariposa County lying north of the Merced River could in the future be provided with supplemental water supplies developed from the South and Middle Fork of the Tuolumne River.

3. The proposed Agua Fria Project appears to offer the most economical means for initial water resource development in Mariposa County. A 50,000-acre-foot reservoir in the vicinity of the confluence of Mariposa and Agua Fria Creeks would create recreation resources with statewide appeal which would greatly accelerate the economic growth of the town of Mariposa and enhance the general economy of the entire county. The provision of supplemental water supplies in Catheys Valley would also promote the growth of this area which is presently retarded because of the scarcity of water. The project would provide about 6,400 acre-feet of supplemental

water for urban and rural residential purposes and for agricultural development in Catheys Valley.

4. A dam and reservoir on the upper reaches of Bear Creek at either the Norwegian Gulch or the Upper Bear Valley site would provide the most economical means for providing supplemental water supplies for the communities of Hornitos and Bear Valley and this general portion of Mariposa County.

5. The municipal, domestic, and industrial water requirements of the Coulterville area could be met by the construction of a dam and reservoir on Maxwell Creek upstream from the town of Coulterville, while an interim water supply could be obtained from the existing McMahon Reservoir. A large dam and reservoir for developing supplemental water for irrigation would not be economically justified on Maxwell Creek.

6. The Bean Creek watershed above Greeley Hill offers an excellent opportunity for development of a reservoir which would provide recreation and a source of water for the development of residential farms. Gentle slopes adjoining the streambed offer no natural site for a dam, but studies made during this investigation indicate that a dam and reservoir would probably be economically justified.

7. A South Fork Merced River Project could be developed and operated as a component of the Merced River Development of the Merced Irrigation District to accomplish increased firm hydroelectric generating capacity and greater irrigation benefits. Provision could be made for future water service to Mariposa County from this project as the demand for supplemental water supplies increas

Recommendations

To provide for the development of supplemental water supplies within the Mariposa area, based upon material presented in this report, it is recommended that:

1. The plans for water resource development presented in this report be considered as a means of providing for future water requirements, but that the plans be reviewed and reevaluated when economic and other conditions permit such development.

2. Mariposa County develop the Agua Fria Project to a capacity of 50,000 acre-feet to maximize total project benefits as the first step in the water supply development for Mariposa County.

3. Mariposa County pursue the developments of the Norwegian Gulch or Upper Bear Valley, Coulterville, and Bean Creek Projects for the purpose of accelerating the economic growth of the county through the provisions of adequate water supplies to the communities of Bear Valley, Hornitos, Coulterville, and Greeley Hill. And that:

   a. Consideration be given to providing a pipeline from the Agua Fria Project to the town of Hornitos as a temporary water supply prior to the development of Bear Creek.

   b. Consideration be given to providing a water supply to Coulterville from the existing McMahon Reservoir through an arrangement with the owner.

4. The Merced Irrigation District study the proposed South Fork Merced River development as an alternative to Bagby Dam and Reservoir under the concept that in the future some additional storage might be incorporated in New Exchequer Dam and Reservoir, the capacity of New Exchequer Powerplant increased, and the South

Fork Merced River development made a component of the enlarged project.

5. Planning for development of the water resources of Mariposa County emphasize development of recreation, fishery and wildlife resources which would attract great numbers of people and provide economic benefits to the County.

A P P E N D I X E S

APPENDIX A

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
LAND CLASSIFICATION STANDARDS

APPENDIX A

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

LAND CLASSIFICATION STANDARDS

Symbol :	Characteristics
	Irrigable Lands
V	These lands are level or slightly sloping and vary from smooth to hummocky or gently undulating relief. The maximum allowable slope is six percent for smooth, reasonably large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils have medium to deep effective root zones, are permeable throughout, and free of salinity, alkalinity, rock, or other conditions limiting crop adaptability of the land. These lands are suitable for all climatically adapted crops.
H	These are lands with greater slope and/or relief than those of the V class. They vary from smooth to moderately rolling or undulating relief. The maximum allowable slope is 20 percent for smooth, reasonably large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils are permeable, with medium to deep effective root zones, and are suitable for the production of all climatically adapted crops. The only limitation is that imposed by topographic conditions.
M	These are lands with greater slope and/or relief than those of the H class. They vary from smooth to steeply rolling or undulating relief. The maximum allowable slope is 30 percent for smooth, reasonably large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils are permeable, with medium to deep effective root zones, and are suitable for the production of all climatically adapted crops. The only limitation is that imposed by topographic conditions.

The foregoing may be modified, as conditions warrant, by use of one or more of the following symbols.

LAND CLASSIFICATION STANDARDS

Symbol :	Characteristics
w	Indicates the presence of a high-water table, which in effect limits the present crop adaptability of these lands to pasture crops. Drainage and a change in irrigation practice would be required to affect the crop adaptability.
s[1/]	Indicates the presence of an excess of soluble salts or exchangeable sodium in slight amounts, which limits the present adaptability of these lands to crops tolerant to such conditions. The presence of salts within the soil generally indicates poor drainage and a medium to high-water table. Reclamation of these lands will involve drainage and the application of small amounts of amendments and some additional water over and above crop requirements in order to leach out the harmful salts.
ss[1/]	Indicates the presence of an excess of soluble salts or exchangeable sodium in sufficient quantity to require the application of moderate amounts of amendments and some additional water over and above crop requirements in order to effect reclamation.
sa[1/]	Indicates the presence of an excess of soluble salts or exchangeable sodium in sufficient quantity to require the application of large amounts of amendments and some additional water over and above crop requirements in order to effect reclamation.
h	Indicates very fine textures, which in general make these lands best suited for the production of shallow-rooted crops.
l[1/]	Indicates fairly coarse textures and low moisture-holding capacities which in general make these lands unsuited for the production of shallow-rooted crops because of the frequency of irrigations required to supply the water needs of such crops.
p	Indicates shallow depth of the effective root zone, which in general limits use of these lands to shallow-rooted crops.
r	Indicates the presence of rock on the surface or within the plow zone in sufficient quantity to prevent use of the land for cultivated crops.
-(L)[2/]	Indicates ground cover varying from a light to moderately dense growth of low brush through a low density growth of medium height trees.

APPENDIX A (Continued)

LAND CLASSIFICATION STANDARDS

Symbol :	Characteristics
-(M)[2/]	Indicates ground cover varying from a high density growth of low brush through a moderately dense growth of medium height to tall trees.
-(H)[2/]	Indicates ground cover varying from a high density growth of medium height trees through a very dense growth of large trees.
	Urban and Recreational Lands
UD[2/]	The total area of cities, towns, and small communities presently used for residential, commercial, recreational and industrial purposes.
SR[2/]	Existing and potential suburban residential areas which have a low population density. These lands are further subdivided into either a high or low water using category. This is indicated by a number in the symbol, i.e., SR-1 includes those lands where it is expected the entire area will be utilized for lawns, gardens, small orchards, etc., and has a high water use. SR-2 indicates lands where a large percentage of the area is expected to be non-water using, hence an area of low water use. All the SR lands are also classed according to the four major topographic classes used for the classification of irrigable lands, i.e., V, H, M, and N.
RR	Existing and potential permanent and summer home tracts within a primarily recreational area. The estimated number of houses, under conditions of full development, is indicated by a number in the symbol, i.e., RR-3 is suitable for three houses per acre.
RC	Existing and potential commercial areas which occur within a primarily recreational area and which include motels, resorts, hotels, stores, etc.
RT	Existing and potential camp and trailer sites within a primarily recreational area.
PP	Existing racetracks, fairgrounds, and private, city, county, state, and federal parks.

APPENDIX A (Continued)

LAND CLASSIFICATION STANDARDS

Symbol :	Characteristics
	Miscellaneous Lands
F	Presently forested lands, or lands subject to forest management, which meet the requirements for irrigable land but which, because of climatic conditions and physiographic position, are better suited for timber production or some type of forest management program rather than for irrigated agriculture.
Va[1/]	Smooth lying valley lands which are affected by such heavy concentrations of salts that further detailed studies would be required to determine the feasibility of reclaiming these lands for irrigated agriculture.
Vm[1/]	Swamp and marsh lands which usually support a heavy growth of phreatophytes and are covered by water most of the time.
N	Includes all lands which fail to meet the requirements of the above classes.

1/ This condition not found in the investigation area.
2/ Not mapped during this survey.

APPENDIX B

WATER QUALITY CRITERIA

APPENDIX B

WATER QUALITY CRITERIA

Criteria presented in the following sections can be utilized in evaluating mineral quality of water relative to existing or anticipated beneficial uses. It should be noted that these criteria are merely guides to the appraisal of water quality. Except for those constituents which are considered toxic to human beings these criteria should be considered as suggested limiting values. A water which exceeds one or more of these limiting values need not be eliminated from consideration as a source of supply, but other sources of better quality water should be investigated.

Domestic and Municipal Water Supply

The following tabulation gives the limiting concentrations of mineral constituents for drinking water, as prescribed by the United States Public Health Service.

UNITED STATES PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS
1962

Constituent	Mandatory limit in ppm
Arsenic (As)	0.05
Barium (Ba)	1.0
Cadmium (Cd)	0.01
Hexavalent chromium (Cr^{+6})	0.05
Cyanide	0.2
Lead (Pb)	0.05
Selenium (Se)	0.01
Silver (Ag)	0.05

Constituent	Nonmandatory, but recommended limit
Alkyl benzene sulphonate (detergent)	0.5
Arsenic (As)	0.01
Carbon chloroform extract (exotic organic chemicals)	0.2

UNITED STATES PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS
1962 (continued)

Constituent	Nonmandatory, but recommended limit
Chloride (Cl)	250
Copper (Cu)	1.0
Cyanide	0.01
Fluoride (F)	0.6-1.7 1/
Iron (Fe)	0.3
Manganese (Mn)	0.05
Nitrate (NO_3)	45
Phenols	0.001
Sulfate (SO_4)	250
Total dissolved solids	500
Zinc (Zn)	5

In addition, the United States Public Health Service recently announced limits on concentrations of radioactivity in drinking waters. These limits are as follows:

Radionuclide	Recommended maximum limits micromicrocuries per liter
$Radium^{226}$	3
$Strontium^{90}$	10
Gross beta activity	1,000 2/

Interim standards for certain mineral constituents have recently been adopted by the California State Board of Public Health. Based on these standards, temporary permits may be issued for drinking water supplies failing to meet the United States Public Health Service Drinking Water Standards, provided the mineral constituents in the following table are not exceeded.

1/ Recommended concentration is based on annual average of maximum daily air temperatures.
2/ In the known absence of strontium -90 and alpha emitters.

UPPER LIMITS OF TOTAL SOLIDS AND SELECTED MINERALS IN DRINKING WATER AS DELIVERED TO THE CONSUMER

	Permit	Temporary permit
Total solids	500 (1000) [2/]	1500 ppm
Sulfates (SO_4)	250 (500) [2/]	600 ppm
Chlorides (Cl)	250 (500) [2/]	600 ppm
Magnesium (Mg)	125 (125)	150 ppm

The California State Board of Public Health has defined the maximum safe amounts of fluoride ions in drinking water in relation to mean annual temperature.

Mean annual temperature	Mean monthly fluoride ion concentration
50°F	1.5 ppm
60°F	1.0 ppm
70°F - above	0.7 ppm

Even though hardness of water is not included in the above standards, it is of importance in domestic and industrial uses. Excessive hardness in water used for domestic purposes causes increased consumption of soap and formation of scale in pipe and fixtures. The following tabulation for degrees of hardness has been suggested by the Department of Water Resources:

Range of hardness, expressed as $CaCO_3$, in ppm	Relative classification
0 - 100	Soft
100 - 200	Moderately hard
200 & greater	Very hard

Irrigation Water

Criteria for mineral quality of irrigation water have been developed by the Regional Salinity Laboratories of the United States Department

2/ Numbers in parentheses are maximum permissible, to be used only where no other more suitable waters are available in sufficient quantity for use in the system.

of Agriculture in cooperation with the University of California. Because of diverse climatological conditions and the variation in crops and soils in California, only general limits of quality for irrigation waters can be suggested. These criteria have limitations in actual practice. In many instances a water may be wholly unsuitable for irrigation under certain conditions of use and yet be completely satisfactory under other circumstances. Consideration also should be given to soil permeability, drainage, temperature, humidity, rainfall, and other conditions that can alter the response of a crop to a particular quality of water.

QUALITATIVE CLASSIFICATION OF IRRIGATION WATERS

Chemical Properties	Class 1 Excellent to Good	Class 2 Good to Injurious	Class 3 Injurious to Unsatisfactory
Total dissolved solids, in ppm	Less than 700	700 - 2000	More than 2000
Conductance, in micromhos at 25°C	Less than 1000	1000 - 3000	More than 3000
Chlorides in ppm	Less than 175	175 - 350	More than 350
Sodium in percent of base constituents	Less than 60	60 - 75	More than 75
Boron in ppm	Less than 0.5	0.5 - 2.0	More than 2.0

Industrial Water Supply

Water quality criteria for industrial waters are as varied and diversified as industry itself. Food processing, beverage production, pulp and paper manufacturing, and textile industries have exacting requirements. However, cooling or metallurgical operations permit the use of poor quality waters. In general, where a water supply meets

drinking water standards, it is satisfactory for industrial use, either directly or following a limited amount of polishing treatment by the industry.

Table B-1 provides water quality values for various industrial uses, as suggested by the Committee on Quality Tolerance for Industrial Uses of the New England Water Works Association.

Fish and Aquatic Life

Water of suitable quality and quantity is a fundamental requirement for the existence of an abundant supply of fish and aquatic life. It is very important that water quality conditions be such as to maintain an abundant supply of food required by fish and other desirable forms of aquatic life. Streams utilized for the propagation of fish and aquatic life should be free of toxic or harmful concentrations of mineral and organic substances and excessive turbidity. Extensive field and laboratory studies conducted by the United States Fish and Wildlife Service show that, among other things, the water in streams supporting a mixed fauna of fresh water fish such as bluegill, bass, crappie and catfish should have the following properties:

(a) Dissolved oxygen not less than 5 ppm (at least 6 ppm for Salmonids),

(b) pH range between 6.5 and 8.5,

(c) Ionizable salts, as indicated by conductivity, between 150 and 500 micromhos at 25° Centigrade, and in general not exceeding 1,000 micromhos.

(d) Ammonia not exceeding 1.5 ppm.

Mineral salts of high toxicity to fish are those of silver, mercury, copper, zinc, lead, cadmium, nickel, trivalent and hexavalent

TABLE B-1

WATER QUALITY TOLERANCE FOR INDUSTRIAL USES[1]
Allowable limits in parts per million

Use	Turbidity	Color	Hardness as $CaCO_3$	Iron[2] as Fe	Manganese as Mn	Total solids	Alkalinity as $CaCO_3$	Odor, taste	Hydrogen sulfide	Miscellaneous Requirements: Health	Miscellaneous Requirements: Other
Air conditioning				0.5	0.5			Low	1		No corrosiveness, slime formation
Baking	10	10		0.2	0.2			Low	0.2	Potable[3]	
Brewing											
Light Beer	10			0.1	0.1	500	75	Low	0.2	Potable[3]	NaCl less than 275 ppm (pH 6.5-7.0).
Dark Beer	10			0.1	0.1	1,000	150	Low	0.2	Potable[3]	NaCl less than 275 ppm (pH 7.0 or more)
Canning											
Legumes	10		25-75	0.2	0.2			Low	1	Potable[3]	
General	10			0.2	0.2			Low	1	Potable[3]	
Carbonated beverages	2	10	250	0.2	0.2	850	50-100	Low	0.2	Potable[3]	Organic color plus oxygen consumed less than 10 ppm.
Confectionery				0.2	0.2	100		Low	0.2	Potable[3]	pH above 7.0 for hard candy.
Cooling	50		50	0.5	0.5				5		No corrosiveness, slime formation.
Food: General	10			0.2	0.2			Low		Potable[3]	
Ice	5	5		0.2	0.2			Low		Potable[3]	SiO_2 less than 10 ppm.
Laundering			50	0.2	0.2						
Plastics, clear,											
Uncolored	2	2		0.02	0.02	200					
Paper and pulp:											
Groundwood	50	20	180	1.0	0.5						No grit, corrosiveness.
Draft pulp	25	15	100	0.2	0.1	300					
Soda and sulfide	15	10	100	0.1	0.05	200					
High-grade light papers	5	5	50	0.1	0.05	200					
Rayon (viscose):											
Pulp production	5	5	8	0.05	0.03	100	total 50; hydroxide 8				Al_2O_3 less than 8 ppm, SiO_2 less than 25 ppm, Cu less than 5 ppm.
Manufacture	0.3		55	0.0	0.0						pH 7.8 to 8.3
Tanning	20	10-100	50-135	0.2	0.2		total 135; hydroxide 8				
Textiles: General	5	20		0.25	0.25						
Dyeing	5	5-20		0.25	0.25	200					Constant composition. Residual alumina less than 0.5 ppm.
Wool scouring		70		1.0	1.0						
Cotton bandage	5	5		0.2	0.2			Low			

1/ Moore, E. W., Progress Report of the Committee on Quality Tolerances of Water for Industrial Uses: Journal New England Water Works Association, Volume 54, Page 271, 1940.
2/ Limit given applies to both iron alone and the sum of iron and manganese.
3/ Potable water, conforming to U.S.P.H.S. standards, is necessary.

chromium, and others. Some pairs of toxicants, such as copper and zinc (also copper and cadmium, nickel and zinc) are far more toxic when combined than when they occur individually. Other toxic substances, when combined, neutralize each other through antagonism or chemical reaction (e.g., free cyanide combines with toxic heavy metal cations, such as nickel and copper ions, to form relatively harmless metallocyanide complexes).

The increasing use of household and industrial detergents, as well as the expansion in the manufacture and use of agriculture insecticides, poses serious hazards to fish and aquatic life. Preliminary studies, for example, indicate that one of the most common household detergents is lethal to relatively hardy fish at very low concentrations. This detergent was lethal to fish in fresh water at concentrations below 0.1 ppm and below 0.005 ppm in salt water. The increase in toxicity in salt water can probably be attributed to the fact that marine fishes must ingest water to maintain their osmotic balance.

Development and use of water resources, including the construction of dams for storage of water, frequently affects water temperatures which in turn affect fish and other aquatic life. Optimum water temperatures for cold water fish, such as trout and salmon, normally lie between 32° and 65° Fahrenheit. The cold water species are generally intolerant of temperatures above 75° Fahrenheit and will seek the lower temperature where possible. Warm water fish such as minnows, carp, catfish, perch, sunfish, and bass normally live in water having temperatures ranging from near 32° to 86° Fahrenheit. Acclimatization enables certain warm water species to live in waters having temperatures as high as 90° Fahrenheit, although they will migrate, where possible, to waters below 86° Fahrenheit.

Classification of Waters

Waters are generally classified according to their quality, character or type. The quality of a water is determined by the kind and quantity of dissolved constituents, expressed as parts per million (ppm), milligrams per liter (mg/l), or by a related characteristic such as electrical conductivity measured in micromhos per centimeter.

The character or type of a water is determined by the relative proportions of mineral constituents. Most dissolved constituents in water are dissociated into charged ions, both cations (positive charge) and anions (negative charge). Substances determined in this study by mineral water analyses and expressed as ions include cations: calcium, magnesium, sodium, and potassium; and anions: carbonate, bicarbonate, sulfate, fluoride, chloride, and nitrate.

Classified Name for Waters

The classified name for waters, with respect to mineral composition, is in terms of the predominant ions. Specifically, the name of an ion is used where it constitutes at least half of its ionic group, expressed in equivalent weights. Where no one ion fulfills the requirement, a hyphenated combination of the two most abundant constituents is used. Thus a calcium bicarbonate water denotes that calcium constitutes at least half of the cations and bicarbonate represents at least half of the anions. Where calcium is predominant but less than half and sodium is next in abundance, the name is modified to calcium-sodium bicarbonate.

APPENDIX C

FISH AND WILDLIFE REPORT

(The material included in this appendix has been taken from a report prepared in 1960 by Earl Gibbs, Fisheries Biologist III, California Department of Fish and Game. The report was entitled "Fish and Wildlife Resources of Mariposa County in Relation to Proposed Water Development Projects")

INTRODUCTION

The California Department of Water Resources has considered several plans for the development of water from the South Fork Merced River for the production of hydroelectric energy and the conservation of water.

In accordance with Inter-Agency Agreement No. 150345, between the Departments of Water Resources and Fish and Game, an investigation was authorized to study the probable effects of proposed water development upon the fish and wildlife resources of the project area. The purpose of the study was to present recommendations for the maintenance and preservation of existing fish and wildlife resources with project development, particularly in the South Fork Merced River watershed. Additional emphasis was placed on evaluating possible enhancement of fish and wildlife resources by the proposed water development projects on Mariposa Creek. The study was conducted by the Contract Services Section of the Water Projects Branch of the Department of Fish and Game. This report presents the results of that study.

METHODS

The investigation was limited primarily to office studies. All available information pertinent to the study was reviewed. The probable effects of the proposed water development on fish and wildlife were reviewed with Department of Fish and Game personnel assigned to the area.

Several field studies were conducted during the investigation on the accessible portions of the South Fork Merced River. Measurements

of stream width, depth, cross-sectional area, and average velocity were made on the South Fork Merced River. Flow recommendations for the maintenance of game fish populations and other aquatic life in the South Fork Merced River were based on these measurements and direct visual observations.

DESCRIPTION OF PROJECT

Present plans for the development of the South Fork Merced River waters envision the diversion of about 108,000 acre-feet of water annually for the primary purposes of producing hydroelectric energy. As shown on Plate 4, the plan proposes the diversion of waters from the South Fork Merced River approximately one-half mile below the confluence of Bishop Creek via a system of conveyance and regulatory structures some 28 miles in length to a point overlooking the Merced River. Here the waters would drop via penstock to a powerhouse and be released into the Merced River. The powerplant is located on the Merced River about five stream miles above the community of Bagby.

The proposed dam on the South Fork of the Merced River would be more than 400 feet in height and would back water up a distance of three miles. Releases of water would be made for the enhancement of the fishery below the dam. Because of the diversion of water for power production the reservoir would fluctuate in large amounts every year. The proposed forebay reservoir at Lyon Gulch at the head of the proposed power conduit was not studied.

AREA DESCRIPTION

The area of investigation lies entirely within the boundaries of Mariposa County. The county is a sparsely settled mountainous area located on the western slope of the Sierra Nevada Mountain Range. The outstanding feature of the county is Yosemite National Park and its world-renowned waterfalls and glaciated domes of granite.

The study area lies within the drainage area of the Merced River and its tributaries. The terrain is generally characterized by deep canyons and steep-sloped mountains. The area is typical of other western Sierra slopes in both plant and animal ecology. Altitudinal extremes of the study area vary from about 800 feet near Bagby to over 7,000 feet in the Chowchilla Mountains. Most of the area falls within the Upper Sonoran life zone, with the higher elevations extending into the typical Sierra Transition life zone. Principal plant indicators of the Upper Sonoran life zone are digger pine (Pinus sabiniana), blue oak (Quercus douglassi), and the hard chaparrel complex. Transition life zone indicators are ponderosa pine (Pinus ponderosa) and black oak (Quercus Kellogii).

Long, hot, dry summers and short, wet winters are characteristic of the area. Maximum daily summer temperatures are usually in the mid-90's but frequently exceed 100 degrees. Precipitation falls primarily as rain, with occasional snow at the higher elevations of the project area. The average annual rainfall is about 30 inches at Mariposa, the county seat.

Three watershed systems, the Merced River, Chowchilla River, and Mariposa Creek, drain the major portion of Mariposa County. These three streams are tributaries of the San Joaquin River which drains the San Joaquin River basin.

The South Fork Merced River and Mariposa Creek were the only streams studied in this investigation. The Merced River system drains an area of approximately 1,020 square miles above Lake McClure and Mariposa Creek drains about 100 square miles of western Mariposa County. The average annual runoff of the Merced River recorded at Lake McClure is about 900,000 acre-feet, and the average annual runoff of Mariposa Creek is about 25,000 acre-feet.

The largest tributary to the Merced River is the South Fork Merced River. The South Fork Merced River drains an area of 239 square miles, with an average annual runoff of about 215,000 acre-feet. Most of the South Fork Merced River watershed lies within the boundaries of Yosemite National Park, with elevations ranging from about 4,000 feet at the western boundary to over 10,000 feet near the crest of the Sierra Nevada. The runoff of the South Fork Merced River is primarily of snow melt origin, characterized by peak flows occurring during the spring and early summer months and low flows during the late summer and fall months. The computed average annual runoff of the South Fork Merced River at the proposed diversion dam site is presented in Table C-1 (Page C-15).

The section of the South Fork Merced River affected by the water development proposal extends from the confluence of the South Fork Merced River with the Merced River upstream to the boundary of Yosemite National Park (see Plate 4). This section of river, some 20 miles in length, lies in a steep and inaccessible canyon. Present access by automobile is limited to the Highway 140 bridge at the mouth of the South Fork Merced River and the Highway 41 bridge at Wawona within Yosemite National Park. A steep, rugged foot trail exists along the side of the canyon from the park downstream to the mouth of the South Fork Merced River.

The South Fork Merced River has a good pool-riffle relationship through most of its length. Large boulder and bedrock areas providing large deep pools are common in the area between the confluences of Zip Creek and Devil Gulch. A falls, approximately 14 feet in height, occurs on the South Fork Merced River just below the confluence of Zip Creek.

Water temperatures in the lower reaches of the South Fork Merced River are normally high during the late summer and fall months, occasionally exceeding 80 degrees Fahrenheit. Air and water temperatures were taken at about three-day intervals throughout the summer and fall months by Mr. and Mrs. Landon, who reside at the mouth of the South Fork Merced River. Temperatures were taken twice a day--8:00 a.m. and 3:00 p.m.--at the Highway 140 bridge crossing the South Fork Merced River. Temperature data for the summer of 1959 are presented in Table C-2 (Page C-17).

Devil Gulch, a tributary to the South Fork Merced River some nine miles below the proposed diversion site, drains an area of about 29 square miles. Runoff is primarily precipitation falling as rain. Peak flows of 250 cfs occur during the winter and spring months, dwindling to little or no flow during the summer and fall months. The average annual acre-feet of runoff of Devil Gulch is presented in Table C-3 (Page C-18).

Mariposa Creek, a minor watershed of 63 square miles at the Agua Fria damsite, drains the western portion of Mariposa County. Stream elevations reach a maximum of 3,300 feet above sea level. Runoff is primarily precipitation falling as rain. Peak flows occur during the winter and spring months with little or no flow during the summer and fall months. The average annual runoff of Mariposa Creek computed at the Agua Fria Dam site ranges between the approximate extremes of 1,500 and 70,000 acre-feet.

FISHERIES WITHOUT THE PROJECT

South Fork Merced River

The major portions of the South Fork Merced River trout fishery lie within the boundaries of Yosemite National Park. Three species of trout, eastern brook trout (Salvelinus fontinalis) brown trout (Salmo trutta) and rainbow trout (Salmo gairdnerii) have been planted in the portion of the river within the park boundaries.

The trout fishery extends downstream from the boundary of Yosemite National Park to the vicinity of the confluence of Devil Gulch with the South Fork Merced River.

The trout fishery between the park boundary and Zip Creek is of minor importance compared to the total trout resources of the river. This section of the river supports self-sustaining populations of brown trout and rainbow trout. Other species of fish are not known to occur there. These trout populations support a relatively small sport fishery. No fish have been planted in this section of the river for several years. Rainbow trout predominate in the catch.

Angling access is limited to a rugged and steep trail which follows the course of the South Fork Merced River from Yosemite National Park to Highway 140 at the mouth of the river. Angling pressure is moderate in the vicinity of Alder Creek; however, very little angling occurs as far downstream as the confluence of Zip Creek.

Between the confluence of Zip Creek and the confluence of Devil Gulch located about seven miles downstream, the river supports populations of rough fish and trout. Among the predominating species of rough fish are Sacramento squaw fish (Ptychocheilus grandis), western sucker (Catostomus

occidentali), and hardhead (Mylopharodon conocephalus). A falls a short distance below the confluence of Zip Creek prevents any farther upstream movement of rough fish.

In the nine-mile section between Devil Gulch and the mouth of the South Fork Merced River, large populations of rough fish and a modest population of smallmouth bass (Micropterus dolomieu) occur. Trout occur seasonally.

Smallmouth bass were planted in the South Fork Merced River in 1941. This initial plant successfully established a population which now supports a small sport fishery of local importance. Smallmouth bass have been reported to occur upstream to one and one-quarter miles above the confluence of Devil Gulch. It is not known why they have not spread farther upstream.

FISHERIES WITH THE PROJECT

South Fork Merced River

The construction of the proposed diversion reservoir at Bishop Creek would inundate about three miles of excellent stream habitat above Bishop Creek.

Preservation of South Fork Merced River fisheries below the proposed dam would require minimal flows of 15 cfs or the natural flow, whichever is less, from June 1 through November, and 10 cfs or the natural flow, whichever is less, the remainder of the year.

Minimum flows for the preservation of game fish in the South Fork Merced River were established by a series of measurements and direct visual observations. The measurements were made near the mouth of the river.

Stream depth, width, and average velocity were measured at four different flows. The inter-relationship of these physical measurements and their effects on a stream environment are not well known. Average depth and width are indicators of total living space, cover, and food producing capacity. Velocity is an important factor influencing streambed profile, plant growth, forms of aquatic life, and other phenomena of stream environment.

Measurements indicated that the lotic character of the South Fork Merced River changes rapidly to a lentic type environment at flows under 13 cfs. Minimum summer flows of 15 cfs would be expected to preserve the desired lotic environment of the river for the maintenance and preservation of trout and smallmouth bass. (Table C-4, page C-20).

Measures to prevent downstream siltation during the construction of the dam would be required. Deposits of silt in the streambed would sharply reduce spawning and food producing areas of the stream.

The overall effect of water development on the South Fork Merced River would be the elimination by inundation of about three miles of stream habitat presently supporting a good trout fishery. The stream habitat and its fisheries below the proposed diversion structure would not be adversely affected, providing stipulated flow recommendations are adopted and if adequate siltation control measures are observed during construction.

South Fork Merced River Reservoir

The reservoir created by the construction of the diversion dam on the South Fork Merced River would present an especially difficult fisheries problem. Because of the rapid turnover of water, diversion reservoirs

resemble slow-moving rivers rather than the typical reservoir, and have all the undesirable features of each.

The proposed reservoir would be steep-sided, narrow, and with very few bays or peninsulas. Under operating schedules presently being considered, the minimum annual fluctuation of water surface elevation would be about 260 feet. Monthly fluctuations would be highly erratic.

The reservoir would not support a good trout fishery because of the unfavorable environment created by the reservoir. The combination of steep shore lines, wide seasonal fluctuations of water surface elevation, and the rapid turnover of water would severely limit the success of any fish population that developed in the reservoir. The basic management problem would be the selection of a suitable game fish and food-chain organisms adaptable to this type of reservoir environment.

WILDLIFE WITHOUT THE PROJECT

Mariposa County has the usual variety of game species found along the western side of the Sierra Nevada. Principal game species are California mule deer, black-tailed deer, black bear, mountain quail, band-tailed pigeons, mourning dove, cottontail and brush rabbits, and tree squirrels.

By far the greatest hunting effort is expended on deer. The heaviest buck kill in Mariposa County occurred in 1939, when 538 were bagged. Both resident and migratory populations of deer occur in Mariposa County. Resident deer are those which winter and summer in the same general area. They are generally found at the lower elevations. Migratory deer spend their summers in the upper reaches of Yosemite National Park and adjacent areas, migrating to the lower elevations of the park and the Chowchilla Mountains

to spend their winters. Migratory movements approximate a distance of 30 air-line miles between the extremes of the winter and summer range boundaries.

Some of the more important fur species taken by licensed trappers in the project area are bobcat (Lynx rufus), coyote (Canis latrans), grey fox (Urocyon cinereoargenteus), raccoon (Procyon lotor), ringtail (Bassariscus astutus), spotted skunk (Spilogale phenax), and opossum (Didelphis verginiana) Many of these fur-bearers live along stream courses.

WILDLIFE WITH THE PROJECT

The construction of any of the proposed reservoirs would have some adverse effects on wildlife populations. The flooding of valley floors and surrounding lower slopes would eliminate wildlife habitat. Displaced resident wildlife populations would not augment populations in adjacent areas as the present range is already being fully utilized. Therefore, any loss of habitat would eliminate those populations now established in the areas of proposed inundation.

The over-all water development plan is a potential threat to deer unless certain precautionary measures are taken. The most serious threat to deer would be to the water conveyance structures which would intercept migration routes and bisect resident deer range.

Even in good physical condition, deer are usually unable to ascend the sides of concrete-lined canals. To prevent excessive losses of deer, canals should be covered or tunneled if feasible. All open canals should have deer-proof fencing on both sides. Crossings or overpasses should be provided at all natural deer crossings and more generally along the canal at a rate of at least eight per mile. All crossings should be covered with soil to a depth of at least six inches.

South Fork Reservoir would inundate some winter range for migratory deer. The reservoir would also inundate some migration routes presently utilized by migratory deer. The over-all effects of these impairments should not prove to be a serious problem to the deer of Mariposa County.

The establishment of better water conditions in the Mariposa Creek watershed would result in better small game distribution and a stable water supply. Waters used for irrigation of new lands or lands which now have an inadequate supply of water should benefit wildlife, especially upland game species such as pheasants (Phasianus colchicus), valley quail (Lophortyx californica) and mourning doves (Zenaidura macroura). A variety of crops would be farmed and the degree of improvement to wildlife would depend largely upon the dominant type of crops. Row crops would offer relatively little wildlife habitat, while other types should be definitely beneficial.

CONCLUSIONS

The Mariposa area water development proposal of the Department of Water Resources has important fisheries enhancement possibilities.

The construction of the South Fork Merced River Diversion Dam would seriously impair about three miles of good trout stream habitat. The dam and reservoir site is near the lower end of the trout habitat; about 9 miles of trout water would remain below the dam. Most of the trout water of the South Fork Merced River lies above the area of inundation and would not be affected.

The trout and smallmouth bass fishery in the South Fork Merced River could be maintained with adequate minimum stream flow releases from the dam.

At best, the fishery in the South Fork Merced River Reservoir would be mediocre. The existing stream fishery in the reservoir basin would

be lost. A small minimum pool would be required to maintain any reservoir fishery that developed.

RECOMMENDATIONS

To insure the maintenance and preservation of existing fish and wildlife resources under the proposed water development plans, the following measures are recommended:

1. Downstream siltation should be prevented during construction of the South Fork Merced River Diversion Reservoir;
2. A minimum flow of 15 cfs, or the natural flow, whichever is less, should be released from the South Fork Merced River Diversion Reservoir from June 1 through November;
3. A minimum flow of 10 cfs, or the natural flow, whichever is less, should be released from the South Fork Merced River Diversion Reservoir from December 1 through May;
4. A minimum pool of 5,000 acre-feet should be maintained in the South Fork Merced River Diversion Reservoir;
5. All open canals should be fenced with deer-proof fencing or covered. If fenced, crossings should be provided at all natural crossings and at a rate of eight per mile generally.

SUMMARY

The Department of Water Resources has presented plans for the development of the South Fork Merced River waters for the production of hydroelectric energy and water conservation. The Departments of Water Resour and Fish and Game authorized an investigation of the probable effects of proposed water development plans upon fish and wildlife resources of Mariposa Co

The purpose of this report was to present the results of that investigation. The report evaluates the effect of the water development proposals on the fish and wildlife resources of the project area.

Studies indicated that the over-all plan of water development would not cause any major problems for fish and wildlife, provided the recommendations submitted in this report were adopted.

A three-mile section of the South Fork Merced River would be inundated by the proposed diversion reservoir. The reduction of this small section of the South Fork Merced River would not appreciably alter the total trout fishery of the South Fork Merced River. The existing fisheries in the section of river below the proposed diversion structure would not be impaired provided that the recommended flows are maintained.

The diversion reservoir is not expected to provide good quality fishing. Diversion reservoirs are normally infertile bodies of water with a low productive capacity for aquatic life.

The reservoir would inundate a small segment of the winter range for migratory deer. This loss of seasonal habitat is of such small magnitude that any adverse effects would be minor.

The conveyance structures, particularly open concrete-lined canals, would pose a serious threat to deer. These potential hazards would be largely nullified by the adoption of preventive measures recommended in the report.

TABLE C-1

ESTIMATED RUNOFF OF THE SOUTH FORK MERCED RIVER AT DIVERSION RESERVOIR BELOW BISHOP CREEK

SEASON	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
1921-22	50	30	2,900	5,780	4,100	8,820	23,400	90,800	115,800	30,600	1,940	140	284,360
23	510	3,900	9,660	5,660	5,660	13,500	26,400	68,600	45,400	19,400	1,230	2,600	202,520
24	3,720	1,600	1,070	2,600	5,580	4,320	18,600	25,100	1,400	80	10	10	64,090
25	3,770	6,620	6,010	3,730	11,800	13,100	28,100	56,800	36,900	8,200	2,380	420	177,830
26	2,880	2,710	4,720	1,920	4,830	14,800	40,600	32,000	6,760	660	40	10	111,930
27	130	7,400	6,790	5,400	12,800	12,400	28,700	54,000	63,900	15,000	1,180	140	207,840
28	3,560	12,800	3,060	4,530	4,450	27,300	21,900	47,200	13,200	1,120	60	30	139,210
29	30	980	1,470	1,310	2,420	10,700	13,800	40,900	22,900	2,250	130	30	96,920
1929-30	20	20	3,580	2,500	5,530	9,150	20,900	24,300	23,800	2,560	160	180	92,700
31	650	1,890	810	1,840	2,940	6,650	16,900	18,600	3,530	200	10	0	54,020
32	120	920	3,000	4,580	9,960	14,400	24,400	58,100	66,000	17,400	920	140	199,940
33	140	150	680	1,160	1,880	6,470	20,100	27,400	43,500	3,940	190	120	105,730
34	740	570	4,030	4,130	4,810	14,300	19,300	13,600	6,890	410	60	220	69,060
35	2,020	8,600	6,940	7,520	9,850	10,270	37,100	65,800	76,300	15,100	670	290	240,460
36	1,640	2,240	1,640	7,460	11,400	17,400	41,000	68,200	51,900	10,000	490	370	213,740
37	680	580	5,640	3,040	20,900	12,000	32,000	99,000	61,900	6,630	410	270	243,050
38	850	3,650	65,800	12,400	13,300	25,700	54,100	123,300	142,800	53,300	3,600	1,000	499,800
39	5,050	5,820	4,030	3,560	4,460	16,000	38,000	27,500	5,820	460	160	1,820	112,680
1939-40	7,980	1,550	3,320	18,800	11,700	25,400	32,900	80,700	47,600	3,740	320	160	234,170
41	720	1,990	12,000	9,130	13,700	19,800	27,900	109,300	89,000	31,200	1,360	250	316,350
42	1,280	10,470	38,700	22,000	5,900	18,700	51,300	91,100	17,000	52,700	2,300	310	311,760
43	360	17,700	13,000	19,100	13,400	26,400	59,000	79,000	53,400	14,300	770	120	296,550
44	1,050	1,810	2,400	4,450	5,040	12,000	19,000	65,300	37,200	7,430	290	130	156,100
45	1,710	13,400	11,700	6,710	21,900	9,560	34,500	65,900	69,700	18,800	840	340	255,060
46	13,800	15,800	15,600	8,970	5,720	14,000	40,100	68,400	37,300	3,990	270	340	224,290
47	2,120	7,150	7,560	3,450	6,900	13,600	24,100	44,400	11,700	670	80	30	121,760
48	6,200	3,510	1,450	4,970	2,610	4,240	16,400	41,400	44,800	5,760	200	170	131,710
49	500	1,090	1,590	1,600	2,810	4,140	36,000	48,900	25,400	1,440	280	230	123,980

(Continued)

TABLE C-1 (Continued)

ESTIMATED RUNOFF OF THE SOUTH FORK MERCED RIVER AT DIVERSION RESERVOIR BELOW BISHOP CREEK

SEASON	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
1949-50	120	1,680	1,090	5,930	6,640	8,500	27,300	46,400	34,800	4,840	400	240	137,940
51	4,660	62,300	37,400	10,370	9,280	14,600	36,900	51,300	32,200	3,340	420	350	263,120
52	1,300	6,140	10,590	8,090	9,250	12,300	49,400	111,400	95,400	51,400	4,150	1,340	360,760
53	330	960	3,020	10,620	4,930	8,470	25,000	23,700	39,700	15,000	590	260	132,580
54	420	2,120	2,670	2,960	8,250	19,000	35,900	53,100	23,900	2,520	270	120	151,230
55	110	2,080	5,570	3,820	5,320	7,920	14,800	42,200	32,100	2,550	200	130	116,800
56	380	650	36,300	20,200	10,800	18,100	36,600	82,200	87,600	38,000	7,600	2,490	340,920
35-year total	69,600	210,880	335,790	240,290	280,820	474,010	1,072,400	2,045,900	1,567,500	444,990	33,980	14,800	6,790,960
35-year mean	1,990	6,020	9,590	6,860	8,020	13,540	30,640	58,450	44,780	12,710	970	420	194,030

TABLE C-2

SOUTH FORK MERCED RIVER TEMPERATURES
May 1959 through September 1959

Date	May Water Temperatures a.m.	May Water Temperatures p.m.	June Water Temperatures a.m.	June Water Temperatures p.m.	July Water Temperatures a.m.	July Water Temperatures p.m.	August Water Temperatures a.m.	August Water Temperatures p.m.	Sept. Water Temperatures a.m.	Sept. Water Temperatures p.m.
1	51	48	--	--	--	--	74	80	--	--
2	44	46	--	--	68	80	--	--	--	--
3	42	45	--	--	--	--	--	--	67	76
4	41	50	56	66	--	--	75	80	--	--
5	45	54	--	--	68	80	--	--	--	--
6	47	56	--	--	--	--	--	--	68	77
7	50	56	--	--	--	--	--	--	--	--
8	51	57	--	--	--	--	77	81	--	--
9	50	54	--	--	68	77	--	--	--	--
10	50	56	--	--	--	--	--	--	--	--
11	53	57	58	68	--	--	--	--	--	--
12	53	56	--	--	74	81	75	80	--	--
13	--	--	--	--	--	--	--	--	--	--
14	55	--	61	69	--	--	--	--	--	--
15	50	58	--	--	--	--	73	78	--	--
16	50	57	--	--	72	80	--	--	--	--
17	52	57	--	--	--	--	--	--	--	--
18	52	58	63	73	--	--	--	--	--	--
19	50	56	--	--	76	81	70	78	--	--
20	49	57	--	--	--	--	--	--	56	62
21	50	60	69	78	--	--	--	--	--	--
22	52	60	--	--	--	--	67	76	--	--
23	51	56	--	--	77	84	--	--	--	--
24	50	54	--	--	--	--	--	--	58	67
25	48	60	72	77	--	--	--	--	--	--
26	46	62	--	--	--	--	64	75	--	--
27	52	62	--	--	76	83	--	--	60	68
28	51	62	70	76	--	--	--	--	--	--
29	52	60	--	--	--	--	--	--	--	--
30	52	60	--	--	--	--	68	76	--	--
31	54	--	--	--	--	--	--	--	--	--

ESTIMATED RUNOFF OF DEVIL GULCH AT MOUTH

SEASON	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
1921-22	30	50	1700	1340	5350	2750	1220	500	110	30	10	10	13,100
23	50	450	3310	3630	2030	1380	2350	570	210	60	20	40	14,100
24	180	200	290	460	420	750	700	110	10	0	0	00	3,120
25	0	730	850	990	8880	3660	3640	1140	520	40	20	30	20,500
26	140	220	270	550	3490	580	1310	200	50	10	10	40	6,870
27	90	1630	850	2830	8490	2540	6060	690	340	70	50	60	23,700
28	150	510	940	500	1740	4200	1810	300	100	30	10	10	10,300
29	80	270	410	530	1320	930	990	490	280	10	0	0	5,310
30	10	40	190	1080	1130	2380	430	420	250	10	0	0	5,940
31	120	620	220	900	1130	530	200	30	0	0	0	0	3,750
32	0	160	5340	4120	10,110	1220	660	650	120	110	10	0	22,500
33	30	130	450	1000	1050	1390	520	610	120	10	0	0	5,310
34	80	50	680	950	1570	310	120	180	120	0	0	0	4,060
35	140	560	1180	5620	1450	5350	11,190	1300	590	90	20	10	27,500
36	70	150	210	3530	14,680	1840	1950	440	440	90	0	0	23,400
37	60	200	310	800	11,600	5810	1660	380	240	60	40	40	21,200
38	240	260	3240	3760	26,080	17,480	4610	1190	360	300	50	30	57,600
39	260	350	500	770	1320	1140	330	140	30	0	0	0	4,840
40	30	80	150	6530	8910	7540	2390	450	.260	30	10	20	26,400
41	140	180	3940	3530	7590	8250	5800	750	610	210	50	50	31,100
42	80	480	5420	7840	7580	3970	6460	3750	840	400	70	110	37,000
43	210	1050	2150	7710	4040	9060	2280	710	280	180	70	60	27,800
44	90	200	210	890	2530	2700	660	340	130	20	10	30	7,810
45	70	1920	1120	840	7160	5110	1400	590	360	30	30	70	18,700
46	420	1270	7000	3040	1980	3390	2040	730	130	40	130	130	20,300
47	250	1170	1330	580	1130	1610	370	190	90	0	0	0	6,720
48	260	590	680	700	1680	8970	11,830	3740	1450	100	0	0	30,000
49	40	170	910	910	3000	9750	1800	560	60	0	0	0	17,200
50	10	210	340	4410	4500	3220	2970	680	310	20	0	30	16,700
51	460	8550	14,940	8030	4990	6860	1850	1710	100	10	0	0	47,500
52	160	770	6360	15,630	5860	12,240	3580	1390	440	260	0	10	46,700
53	40	380	3020	4730	1140	1980	2120	1100	690	0	0	0	15,200
54	130	560	1000	3160	4810	9550	3730	710	550	0	0	0	24,200

(Continued)

TABLE C-3 (Continued)

ESTIMATED RUNOFF OF DEVIL GULCH AT MOUTH

SEASON	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
1954-55	0	320	1530	5050	1700	1420	1820	1710	150	0	0	0	13,700
56	0	180	30,490	19,320	5500	3300	2760	2490	640	120	0	0	64,800
35-Yr. Total	4120	24,660	101,530	126,260	175,940	153,160	93,610	30,940	10,980	2340	610	780	724,930
35-Yr. Mean	120	700	2900	3610	5030	4380	2670	880	310	70	20	20	20,710

TABLE C-4

RECOMMENDED RELEASES FOR THE MAINTENANCE AND PRESERVATION OF FISHERIES RESOURCES IN THE SOUTH FORK MERCED RIVER

Month	Recommended Release Cubic Feet/Second	Acre-Feet
January	10	600
February	10	600
March	10	600
April	10	600
May	10	600
June	15	900
July	15	900
August	15	900
September	15	900
October	15	900
November	15	900
December	10	600

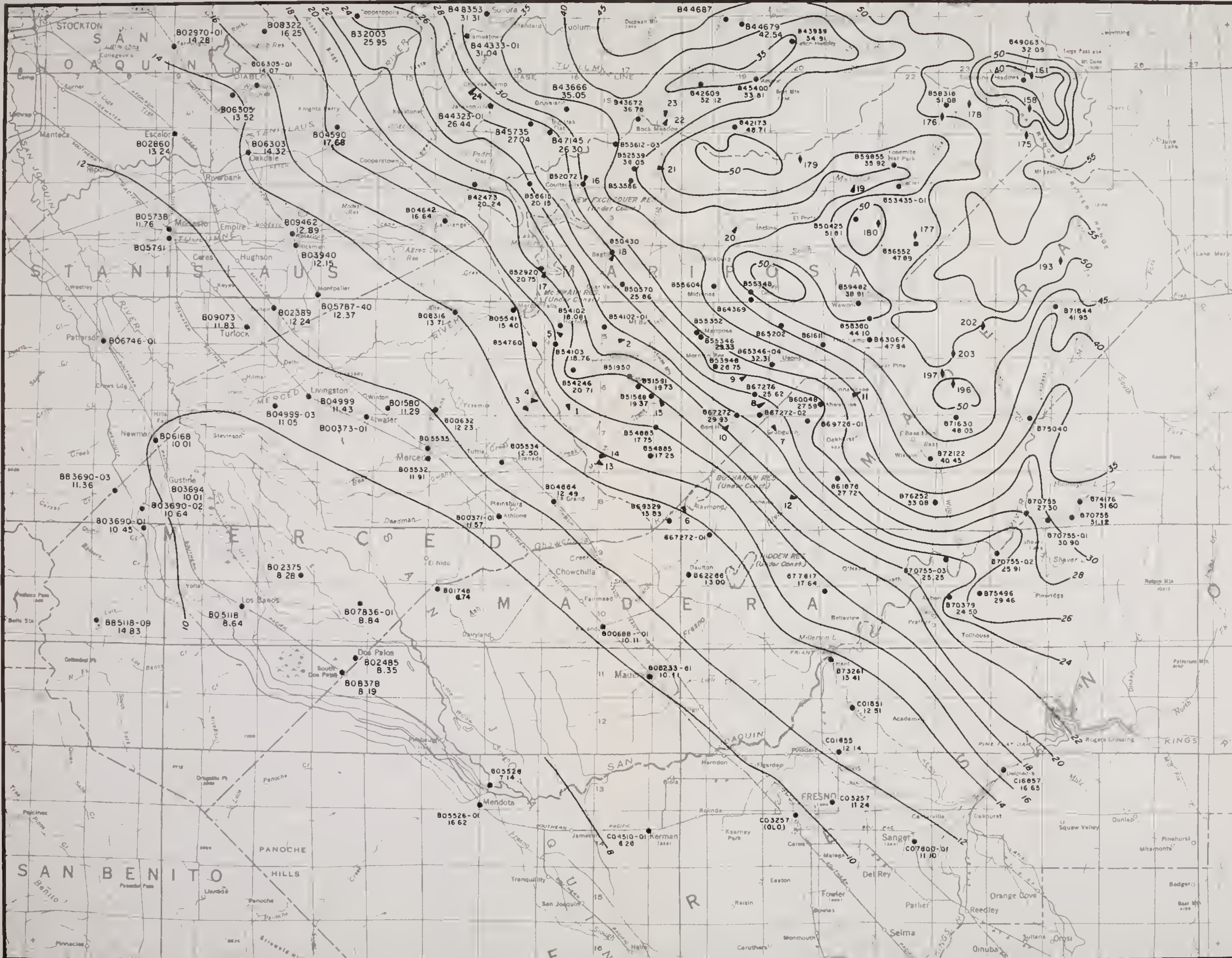
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

LOCATION OF MARIPOSA AREA

1965

SCALE OF MILES
0 20 40 60 80


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION
LOCATION OF
MARIPOSA AREA
1965
SCALE OF MILES
0 20 40 60 80
OREGON
NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
COLUSA
SONOMA
NAPA
YUBA
TUOLUMNE
MONO
CONTRA COSTA
ALAMEDA
SAN JOAQUIN
STANISLAUS
MERCED
SANTA CLARA
SAN BENITO
MADERA
FRESNO
INYO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL



LEGEND

- LINES OF EQUAL ANNUAL PRECIPITATION
- PRECIPITATION STATIONS
- SNOW COURSES
- STREAM GAGING STATIONS

(With Map Reference Number)

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

LINES OF EQUAL AVERAGE PRECIPITATION

1965

SCALE OF MILES

0 8 16 24

LEGEND

LAND USE 1959

- [I] IRRIGATED LANDS
- [R] RECREATIONAL LANDS
- [U] URBAN LANDS

CLASSIFICATION OF LANDS

- [A] IRRIGABLE LANDS
- [F] IRRIGABLE LANDS BEST SUITED TO FOREST MANAGEMENT
- [S] POTENTIAL RECREATIONAL LANDS
- [N] NATIVE VEGETATION
- BOUNDARY OF MARIPOSA AREA INVESTIGATION

NOTE: ALL LANDS IN MARIPOSA COUNTY EXCEPT WITHIN YOSEMITE NATIONAL PARK WERE CLASSIFIED

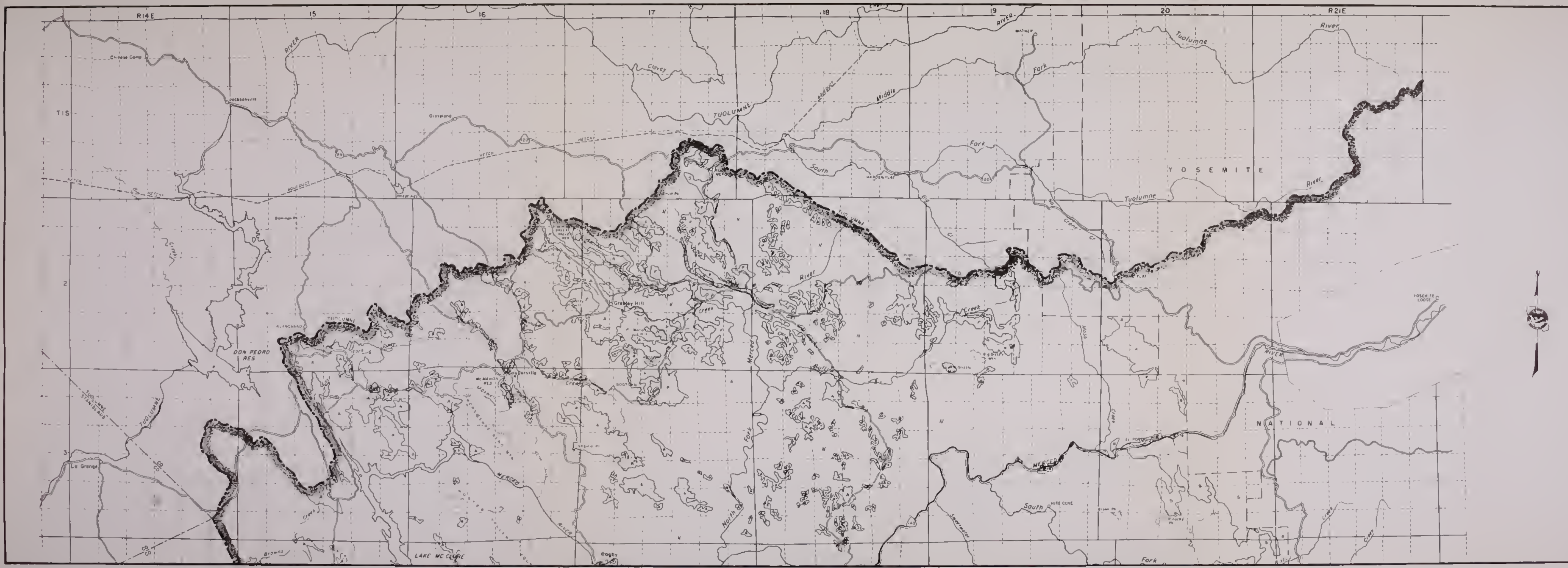
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS
AND
1959 LAND USE

SCALE OF MILES

2 0 2 4

PLATE 3-A



LEGEND

LAND USE 1959

I	IRRIGATED LANDS
R	RECREATIONAL LANDS
U	URBAN LANDS

CLASSIFICATION OF LANDS

A	IRRIGABLE LANDS
F	IRRIGABLE LANDS BEST SUITED TO FOREST MANAGEMENT
S	POTENTIAL RECREATIONAL LANDS
N	NATIVE VEGETATION
	BOUNDARY OF MARIPOSA AREA INVESTIGATION

NOTE ALL LANDS IN MARIPOSA COUNTY EXCEPT WITHIN YOSEMITE NATIONAL PARK WERE CLASSIFIED

STATE OF CALIFORNIA
THE RESOURCES AGENCY
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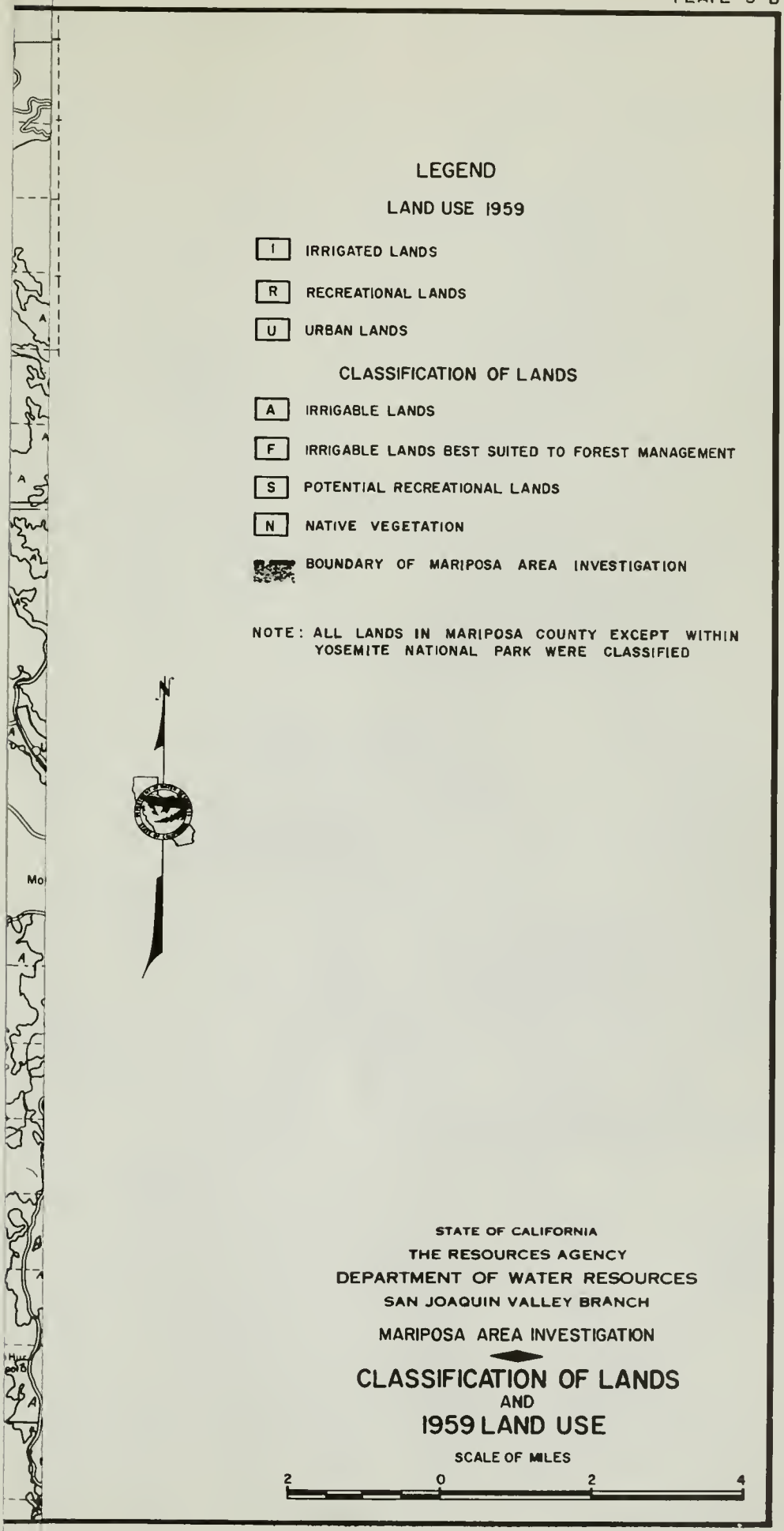
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS AND 1959 LAND USE

SCALE OF MILES

2 0 2 4



LEGEND

LAND USE 1959

- I — IRRIGATED LANDS
- R — RECREATIONAL LANDS
- U — URBAN LANDS

CLASSIFICATION OF LANDS

- A — IRRIGABLE LANDS
- F — IRRIGABLE LANDS BEST SUITED TO FOREST MANAGEMENT
- S — POTENTIAL RECREATIONAL LANDS
- N — NATIVE VEGETATION
- BOUNDARY OF MARIPOSA AREA INVESTIGATION

NOTE: ALL LANDS IN MARIPOSA COUNTY EXCEPT WITHIN YOSEMITE NATIONAL PARK WERE CLASSIFIED

N

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

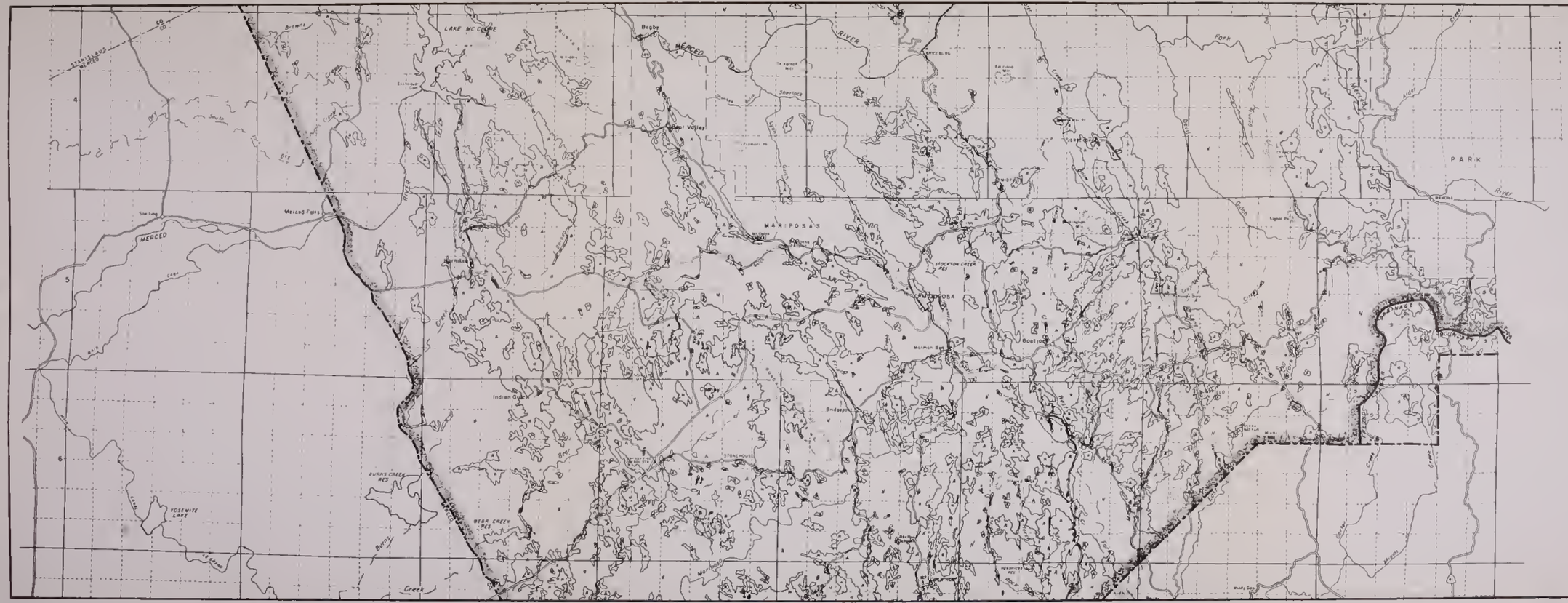
MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS AND 1959 LAND USE

SCALE OF MILES

2 0 2 4

PLATE 3-8



LEGEND

LAND USE 1959

- I IRRIGATED LANDS
- R RECREATIONAL LANDS
- U URBAN LANDS

CLASSIFICATION OF LANDS

- A IRRIGABLE LANDS
- F IRRIGABLE LANDS BEST SUITED TO FOREST MANAGEMENT
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SAN JOAQUIN VALLEY BRANCH

MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS AND 1959 LAND USE

SCALE OF MILES

2 0 2 4

LEGEND

LAND USE 1959

- [I] IRRIGATED LANDS
- [R] RECREATIONAL LANDS
- [U] URBAN LANDS

CLASSIFICATION OF LANDS

- [A] IRRIGABLE LANDS
- [F] IRRIGABLE LANDS BEST SUITED TO FOREST MANAGEMENT
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DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS
AND
1959 LAND USE

SCALE OF MILES

2 0 2 4

PLATE 3

LEGEND

LAND USE 1959

- I IRRIGATED LANDS
- R RECREATIONAL LANDS
- U URBAN LANDS

CLASSIFICATION OF LANDS

- A IRRIGABLE LANDS
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DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

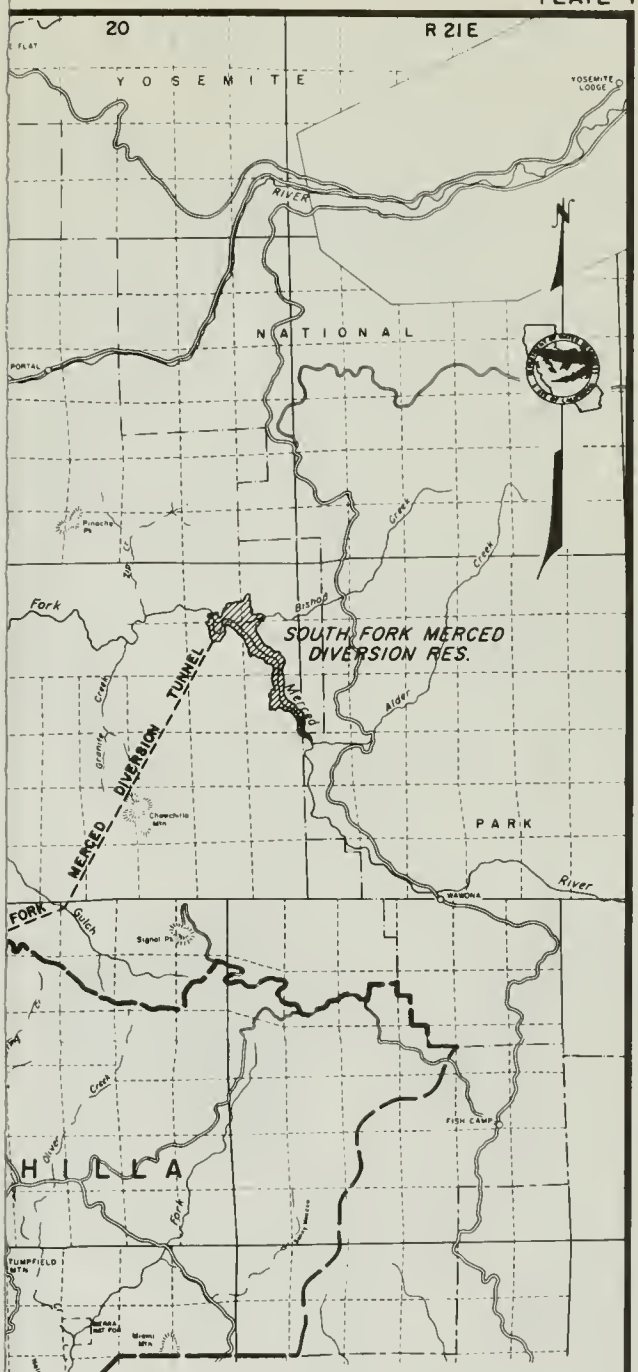
MARIPOSA AREA INVESTIGATION

CLASSIFICATION OF LANDS AND 1959 LAND USE

SCALE OF MILES

2 0 2 4

PLATE 4



STATE OF CALIFORNIA

THE RESOURCES AGENCY

DEPARTMENT OF WATER RESOURCES

SAN JOAQUIN VALLEY BRANCH

MARIPOSA AREA INVESTIGATION

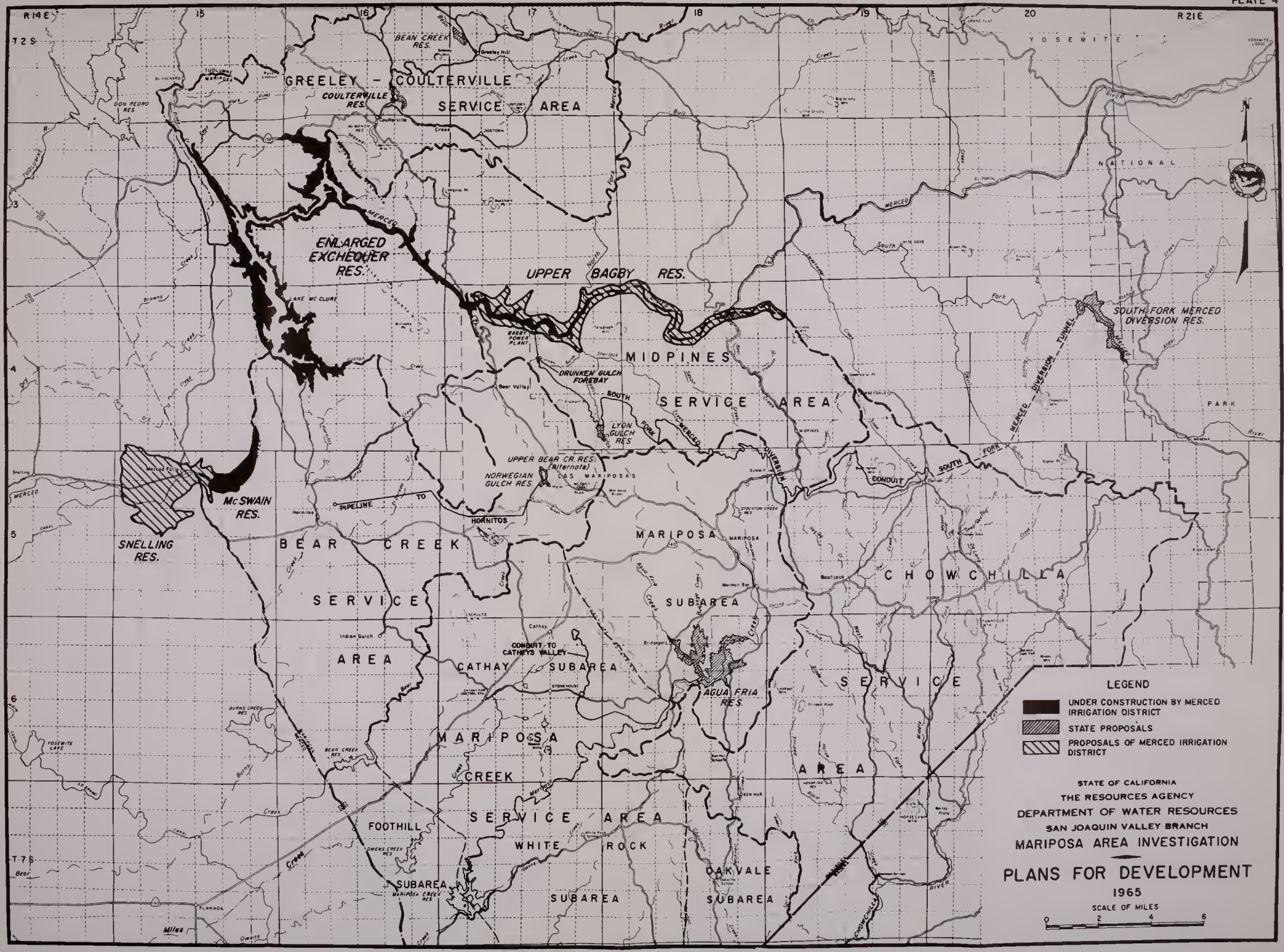
PLANS FOR DEVELOPMENT

1965

SCALE OF MILES

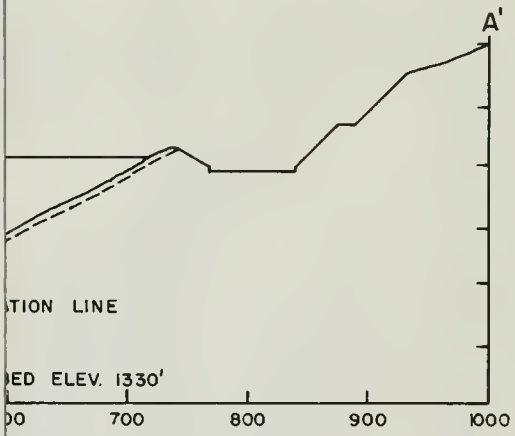
0 2 4 6

PLATE 4


R 14 E
15
16
17
18
19
20
R 21 E
T 2 S
T 7 S
GREELEY - COULTERVILLE SERVICE AREA
COULTERVILLE RES.
BEAN CREEK RES.
DON PEDRO RES
YOSEMITE
NATIONAL
PARK
ENLARGED EXCHEQUER RES.
LAKE MC CLURE
UPPER BAGBY RES.
BAGBY POWER PLANT
SOUTH FORK MERCED DIVERSION RES.
MERCED DIVERSION TUNNEL
MIDPINES SERVICE AREA
DRUNKEN GULCH FOREBAY
LYON GULCH RES
SOUTH FORK MERCED RIVER
CONDUIT
UPPER BEAR CR. RES. (Alternate)
NORWEGIAN GULCH RES.
LAS MARIPOSAS
McSWAIN RES.
SNELLING RES.
PIPELINE TO HORNITOS
BEAR CREEK SERVICE AREA
MARIPOSA SUBAREA
CHOWCHILLA SERVICE AREA
CONDUIT TO CATHEYS VALLEY
CATHAY SUBAREA
AGUA FRIA RES.
MARIPOSA CREEK SERVICE AREA
FOOTHILL WHITE ROCK SUBAREA
OAKVALE SUBAREA
LEGEND
UNDER CONSTRUCTION BY MERCED IRRIGATION DISTRICT
STATE PROPOSALS
PROPOSALS OF MERCED IRRIGATION DISTRICT
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION
PLANS FOR DEVELOPMENT
1965
SCALE OF MILES
0 2 4 6

T. 5 S.

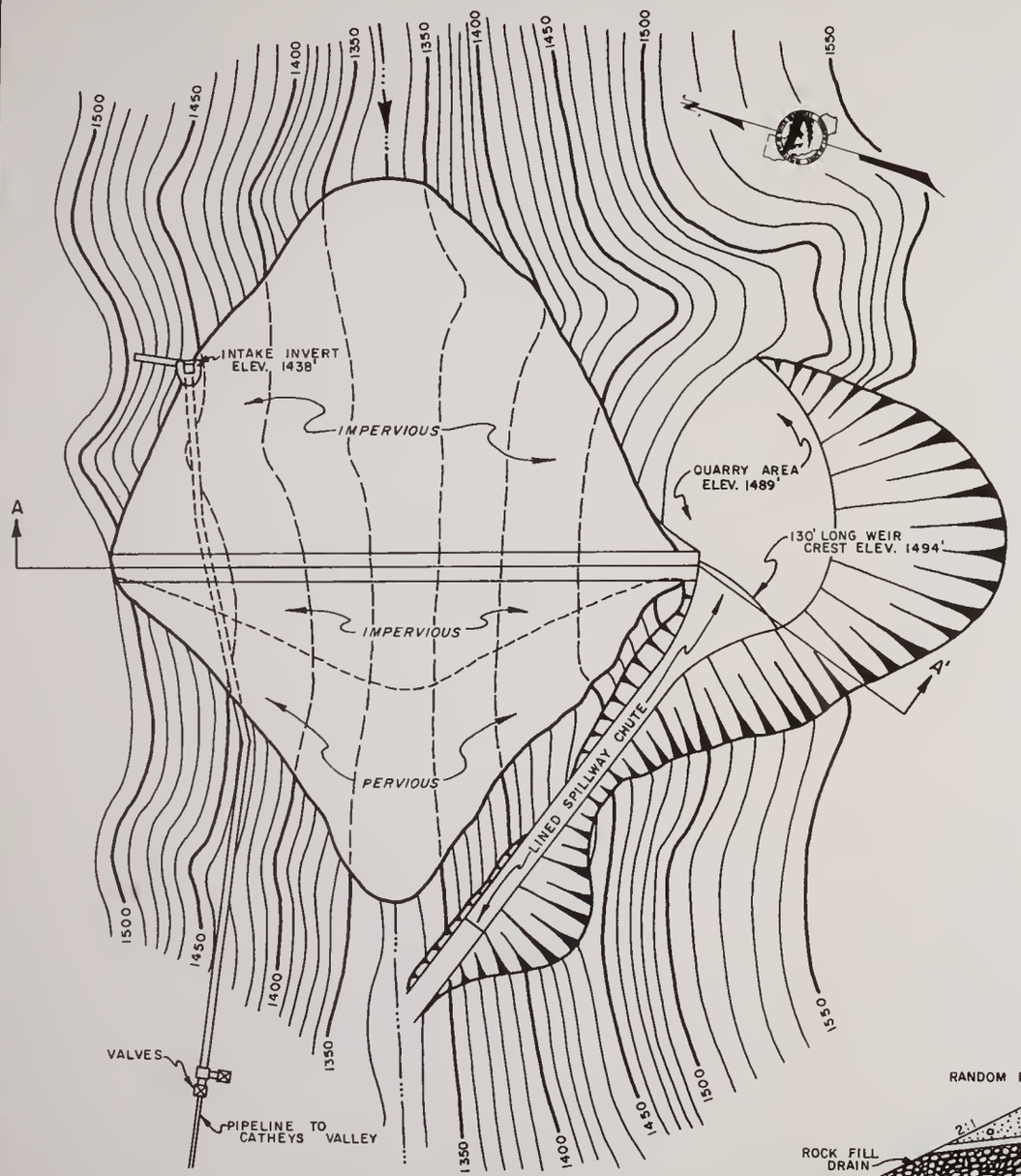
T. 6 S.



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

AGUA FRIA PROJECT

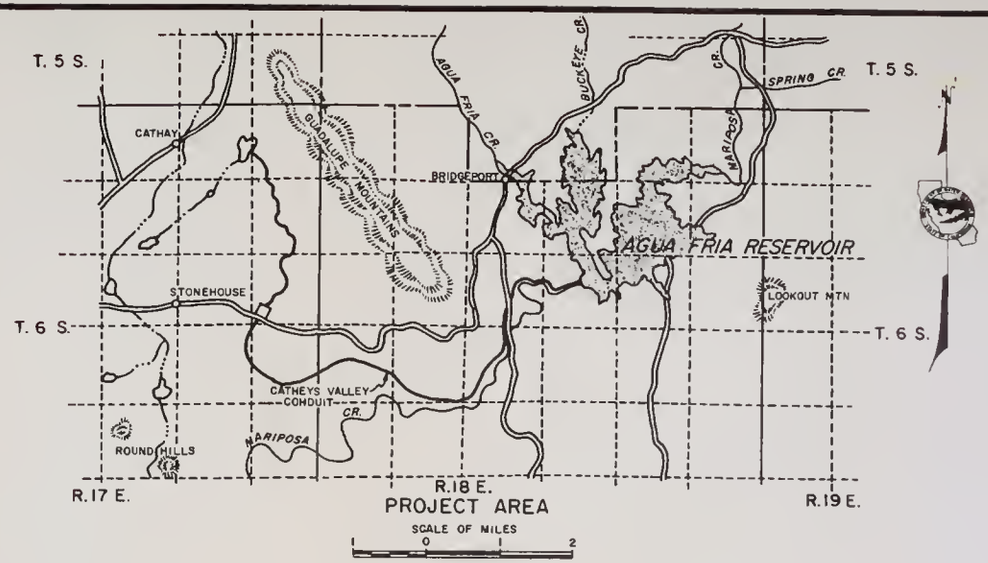
1965



GENERAL PLAN

SCALE OF FEET

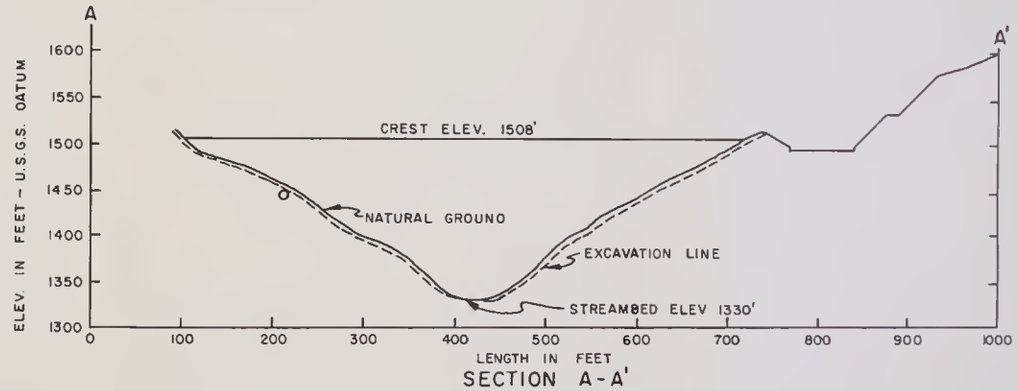
100 0 100 200



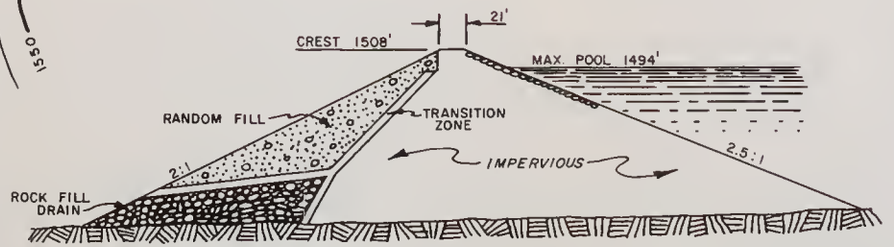
PROJECT AREA

SCALE OF MILES

0 2



SECTION A-A'



SECTION OF DAM

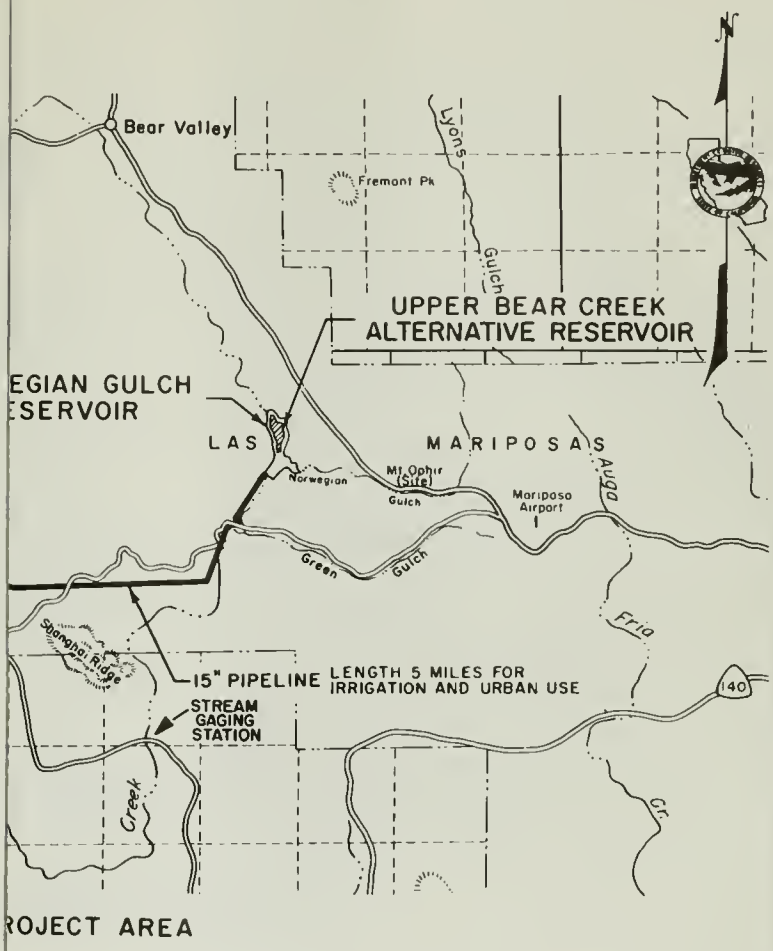
SCALE OF FEET

100 0 100 200

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

AGUA FRIA PROJECT

1965

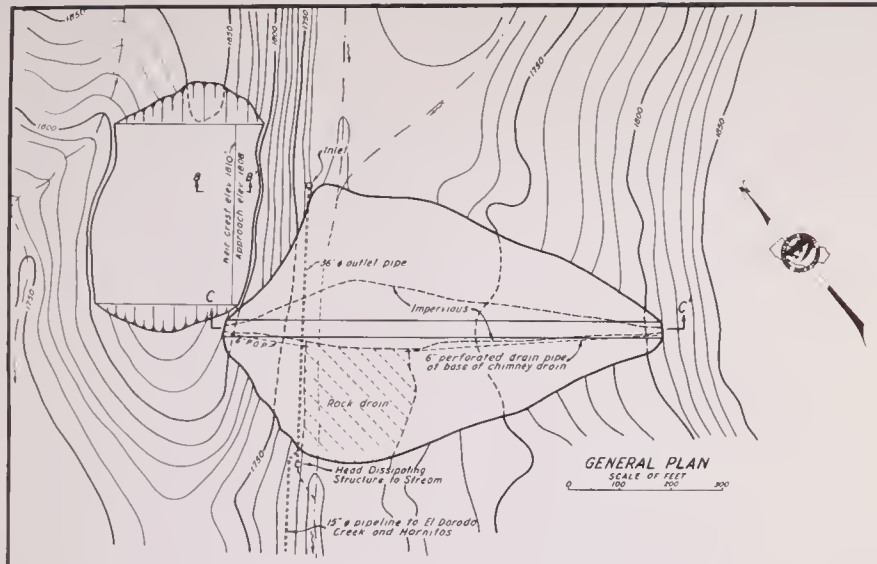


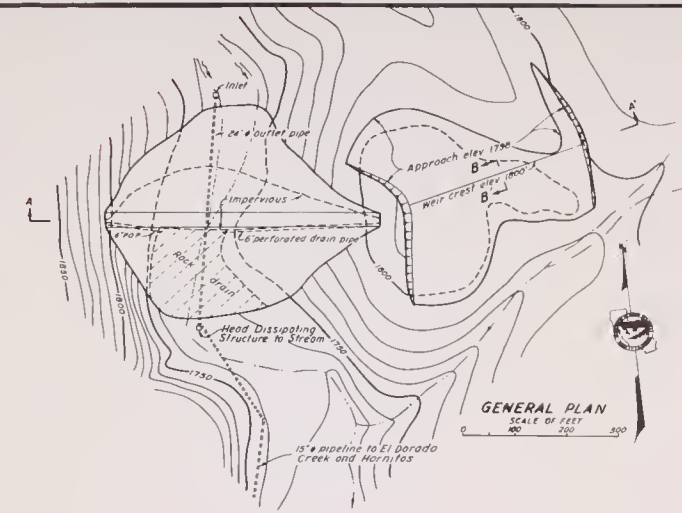
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

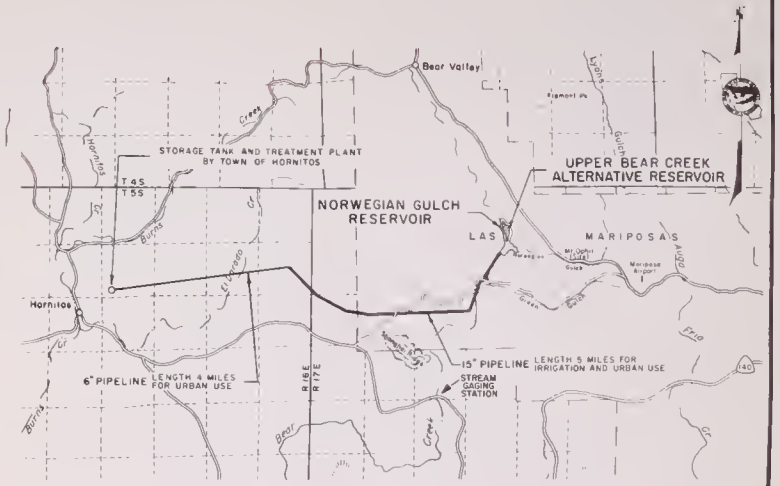
MARIPOSA AREA INVESTIGATION

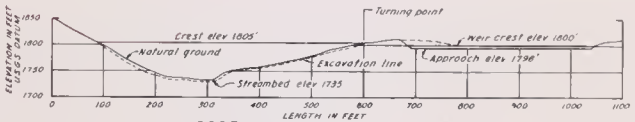
NORWEGIAN GULCH PROJECT
AND
UPPER BEAR VALLEY PROJECT

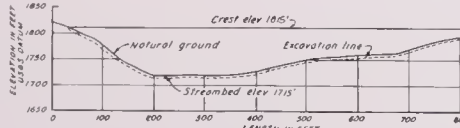
1965

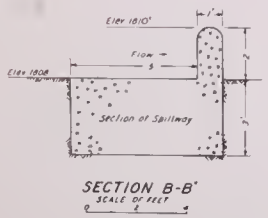


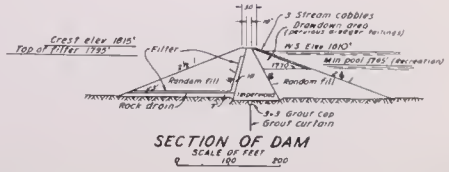




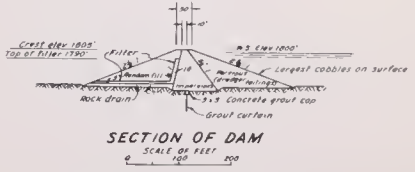








NORWEGIAN GULCH DAM

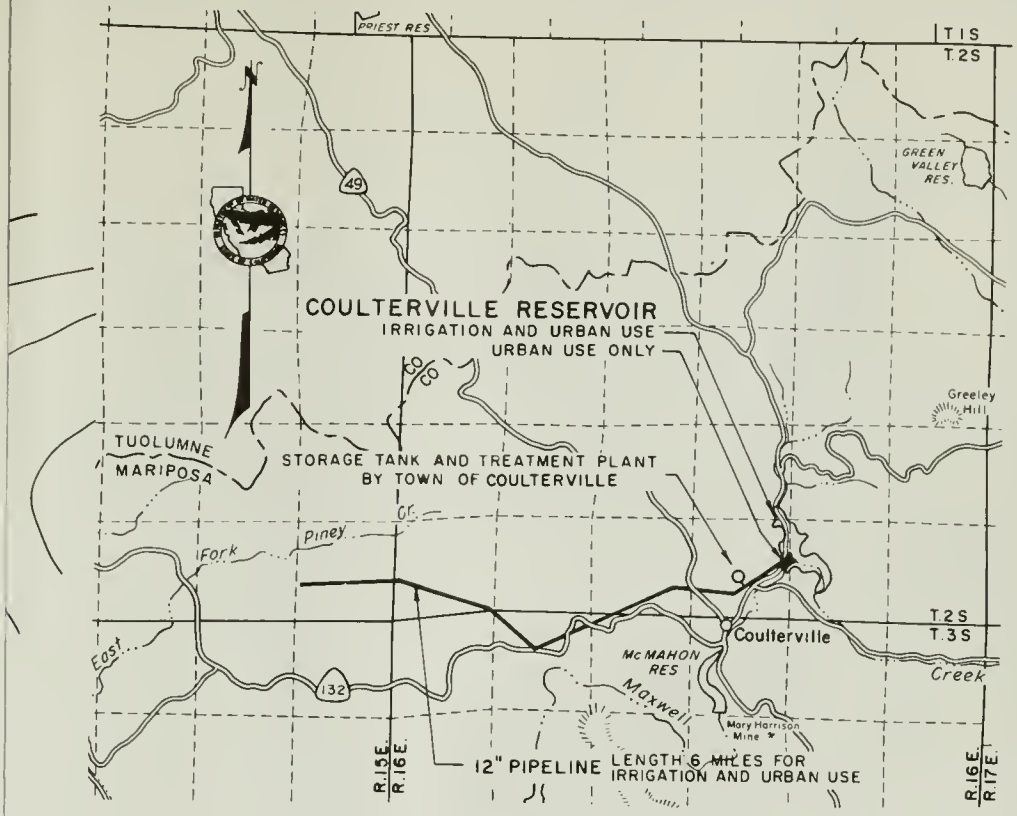


UPPER BEAR CREEK ALTERNATIVE DAM

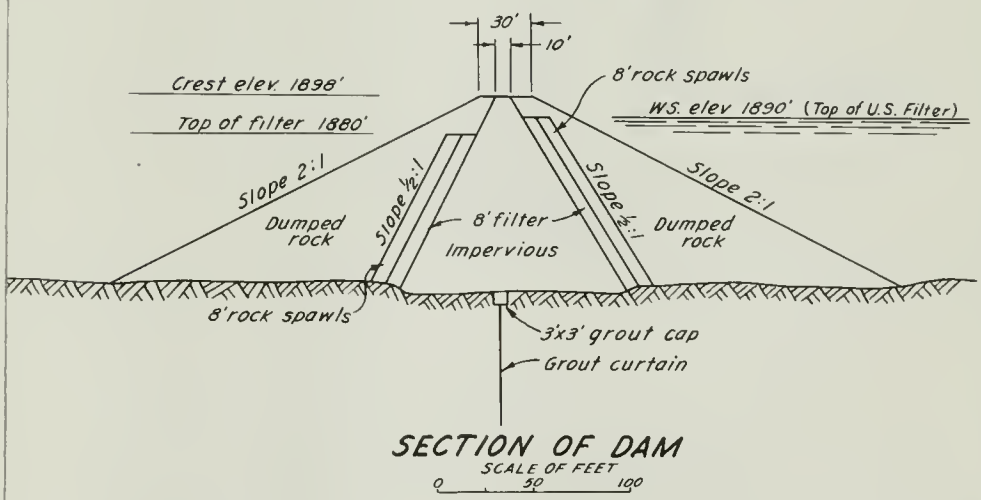
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

NORWEGIAN GULCH PROJECT AND UPPER BEAR VALLEY PROJECT

1965



PROJECT AREA

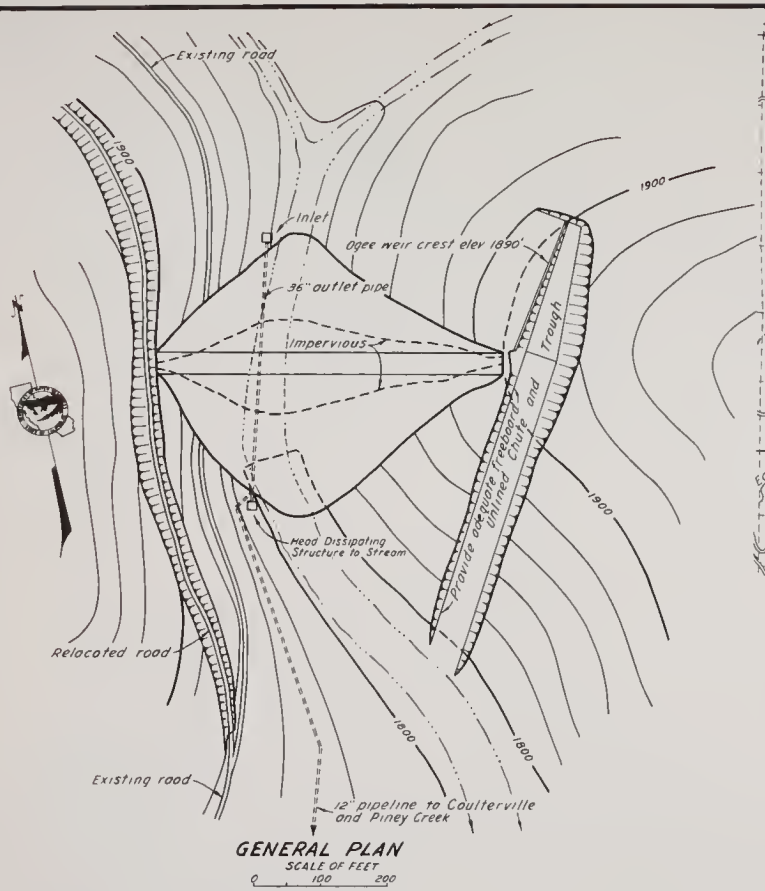


SECTION OF DAM

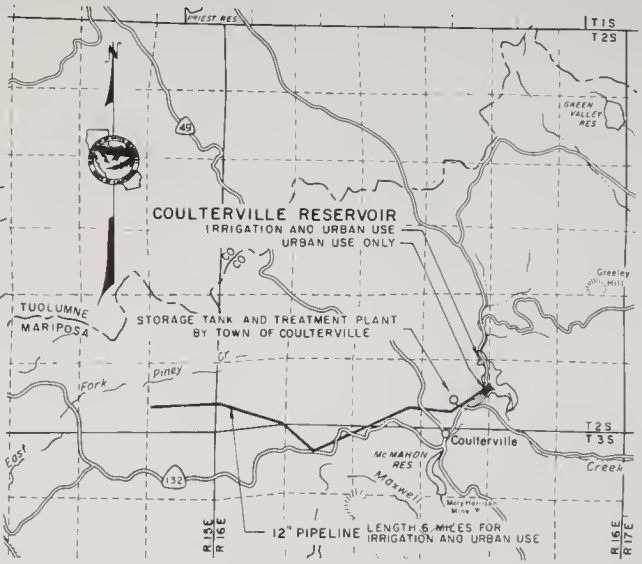
SCALE OF FEET
0 50 100

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

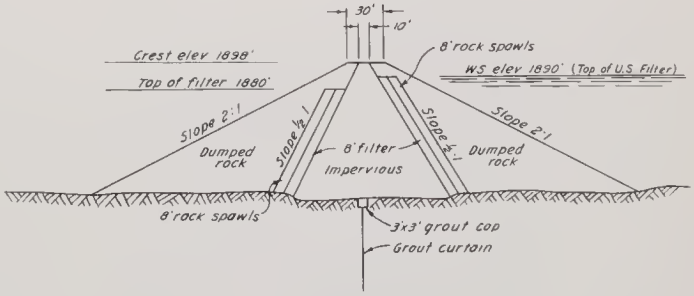
COULTERVILLE PROJECT
1965



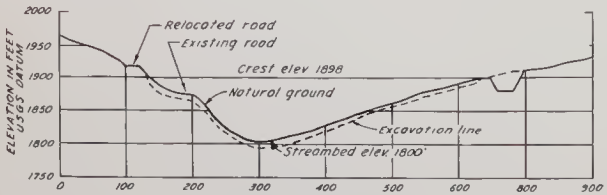
GENERAL PLAN
SCALE OF FEET
0 100 200



PROJECT AREA



SECTION OF DAM
SCALE OF FEET
0 50 100

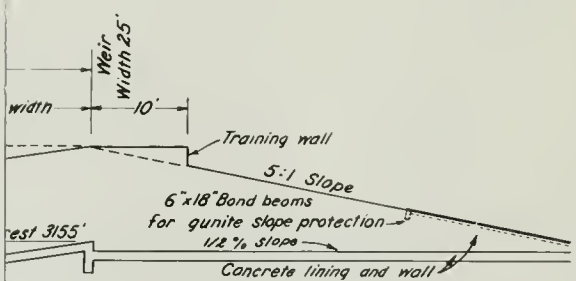


PROFILE OF DAM
LOOKING UPSTREAM

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

COULTERVILLE PROJECT
1965

ECT AREA

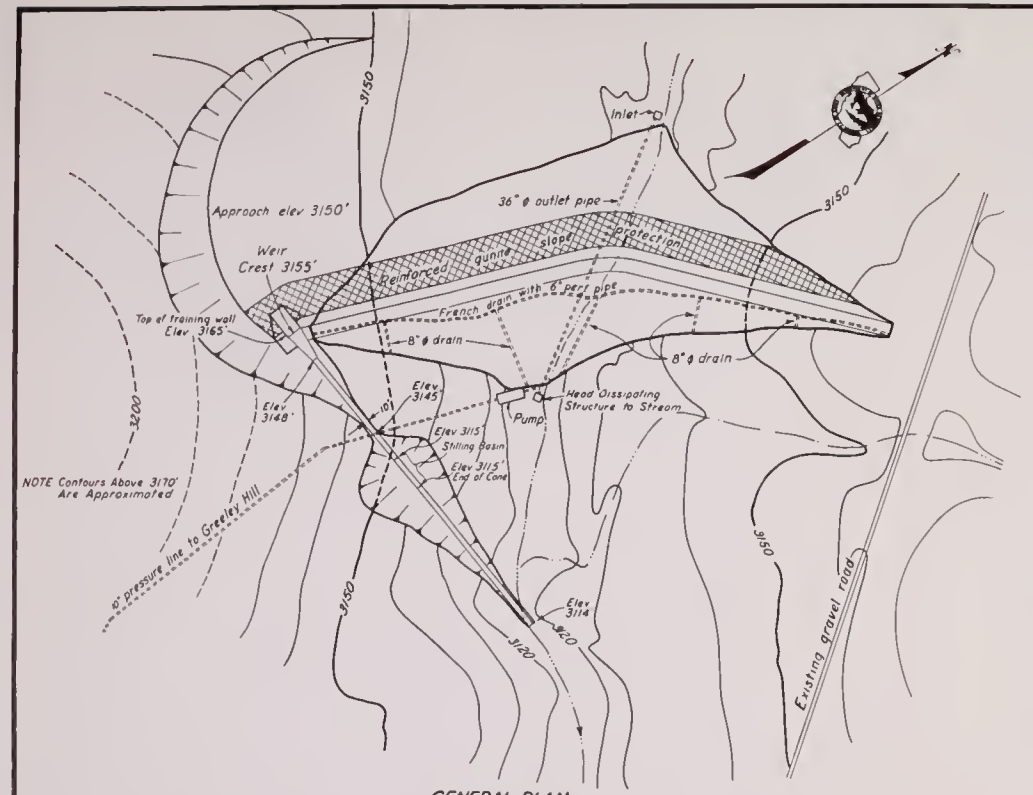


OFILE OF SPILLWAY

SCALE OF FEET
10 20

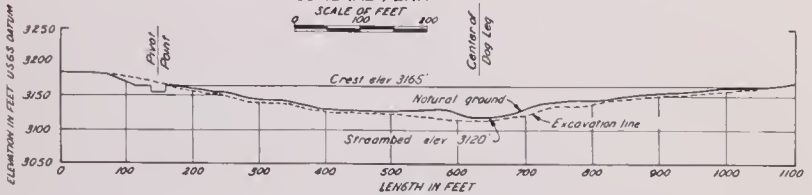
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

BEAN CREEK PROJECT
1965

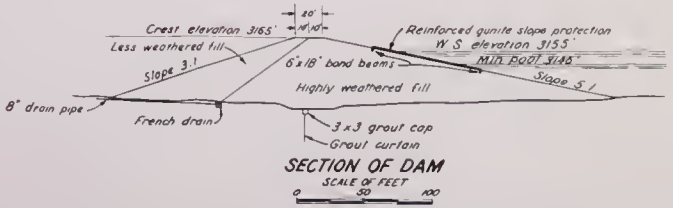


GENERAL PLAN

SCALE OF FEET
0 100 100

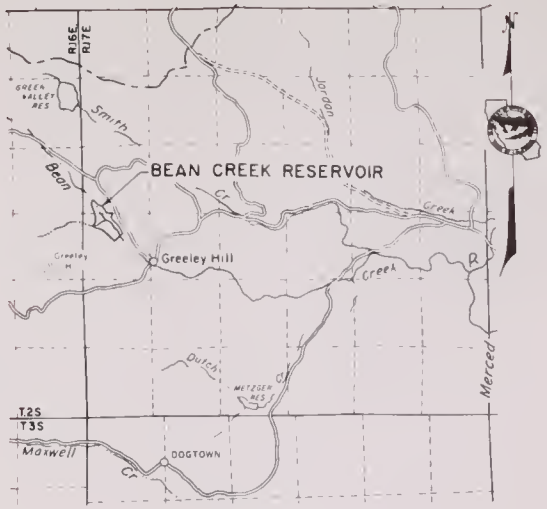


PROFILE OF DAM
LOOKING UPSTREAM

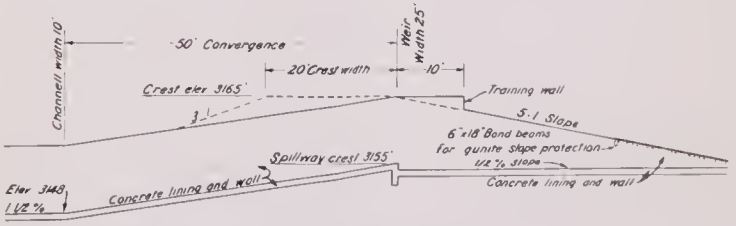


SECTION OF DAM

SCALE OF FEET
0 50 100



PROJECT AREA



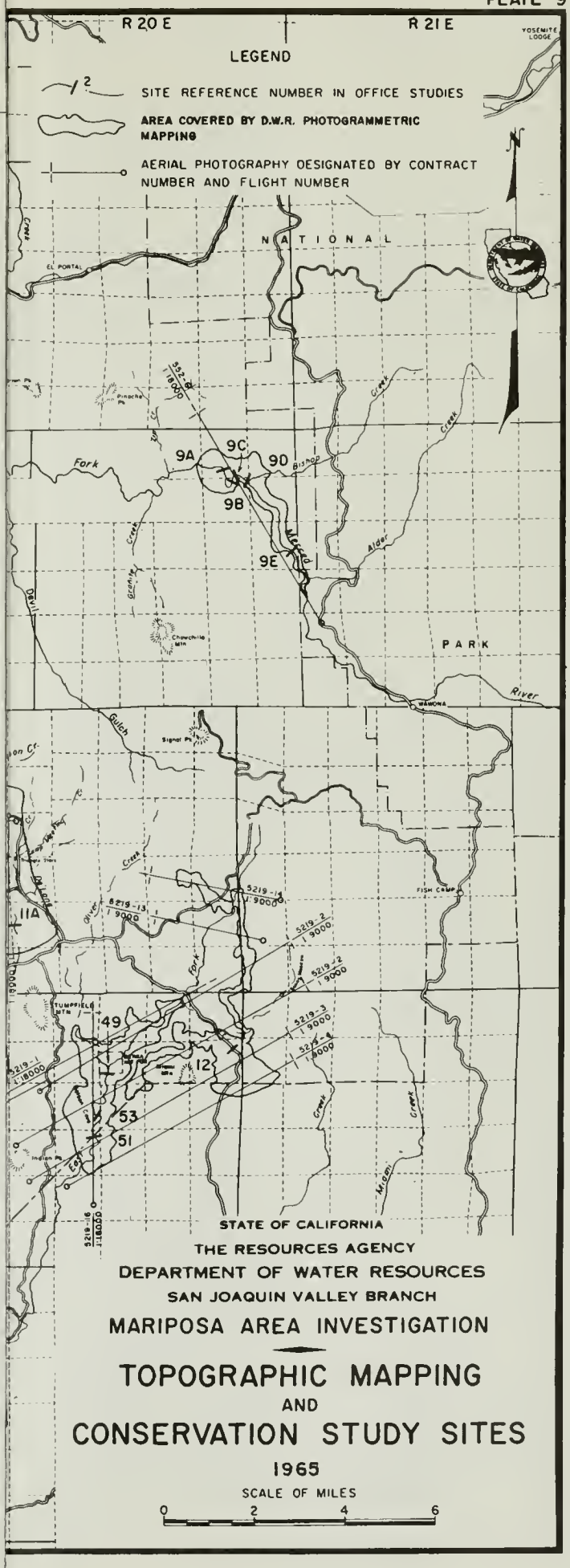
PROFILE OF SPILLWAY

SCALE OF FEET
0 10 20

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
MARIPOSA AREA INVESTIGATION

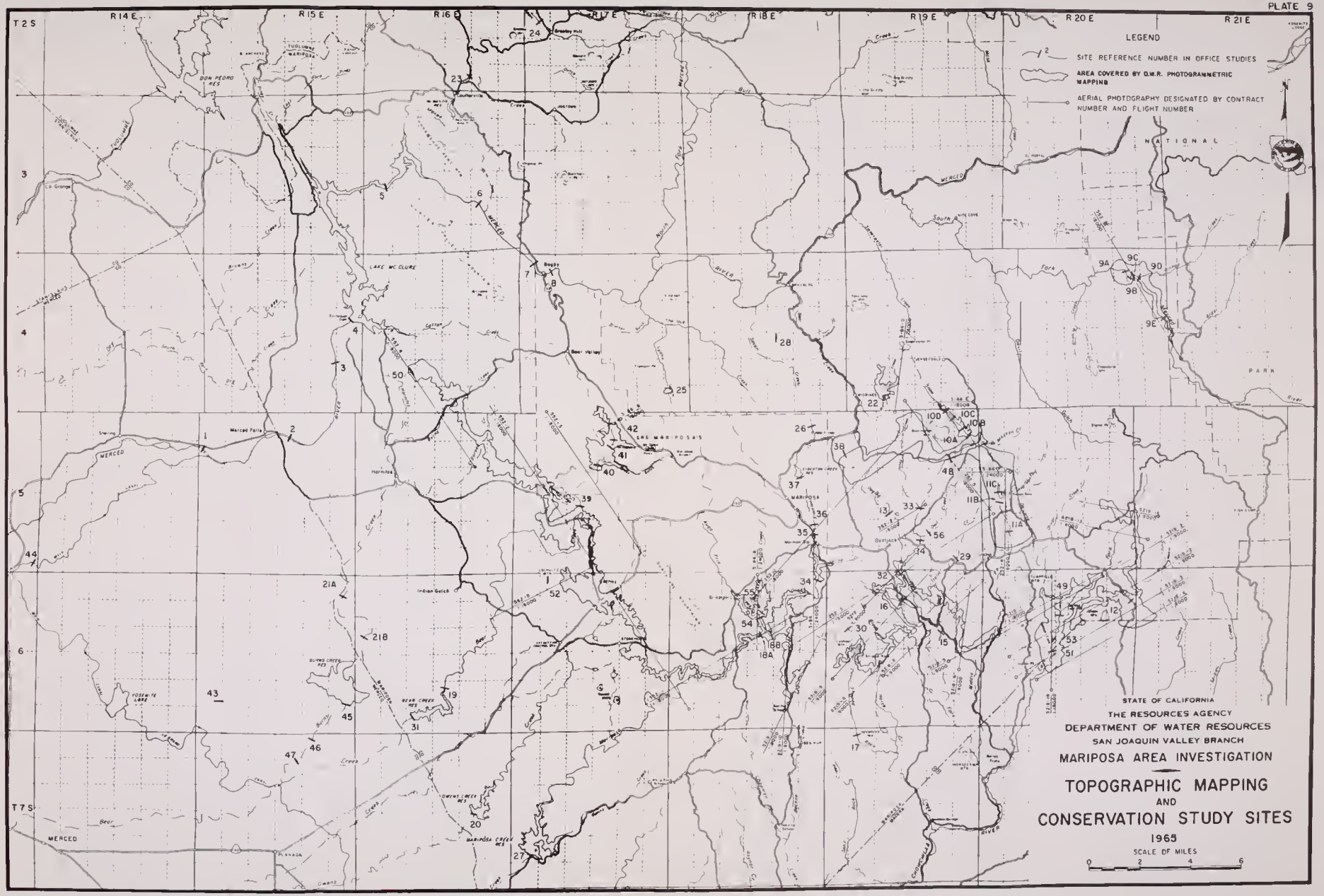
BEAN CREEK PROJECT
1965

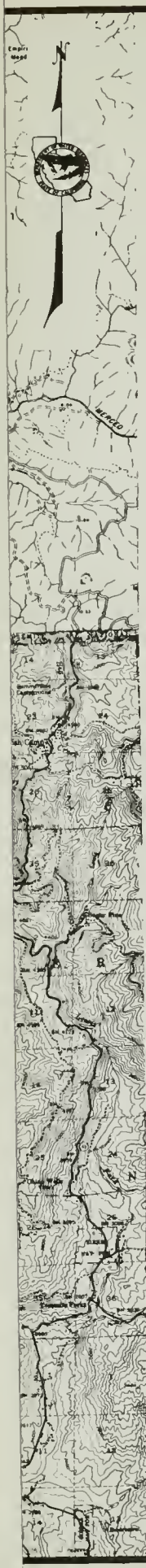
SITE REFERENCE NUMBER



INDEX TO SITE MAPPING

SITE REFERENCE NUMBER	NAME OF SITE	SCALE OF MAP	NAME OF AGENCY OR NAME OF U.S.G.S. QUADRANGLE
1	SNELLING	7½ MINUTE	SNELLING
2	MERCED FALLS	7½ MINUTE	MERCED FALLS
3	JONES FLAT	7½ MINUTE	MERCED FALLS
4	EXCHEQUER	1" = 100'	U S E D
5	HORSESHOE BEND	1" = 100'	U S E D
6	VIRGINIA POINT	1" = 100'	U S E D.
7	LOWER BAGBY	1" = 400'	U S E D
8	UPPER BAGBY	1" = 400'	U S E D
9	SOUTH FORK MERCED	1" = 400'	D W R
10	SNOW CREEK	1" = 400'	D W R
11	MAGOON CREEK	1" = 400'	D W R
12	MIAMI MOUNTAIN	1" = 400'	D W R
13	PEGLEG	1" = 200'	D W R
14	BOOTJACK	1" = 100'	D W R
15	WILDCAT	1" = 100'	D W R
16	HUMBUG	1" = 24 000	MARIPOSA
17	STRIPED ROCK	1" = 200'	D W R
18	AGUA FRIA	1" = 400'	D W R
19	INDIAN GULCH	1" = 62 500	INDIAN GULCH
20	OWENS CREEK	1" = 400	U S E D
21	LA PALOMA	7½ MINUTE	HAYSTACK MTN
22	PLUMBAR	1" = 400'	D W R
23	COULTERVILLE	1" = 200'	D W R
24	BEAN CREEK	1" = 400'	S C S
25	LYON GULCH	1" = 100'	D W R
26	MONO GULCH	1" = 62 500	MARIPOSA
27	MARIPOSA CREEK	1" = 400'	U S E D
28	COLORADO FOREBAY	1" = 24 000	BEAR VALLEY
29	ITALIAN CREEK	1" = 24 000	STUMPFIELD MTN
30	LOOKOUT MOUNTAIN FOREBAY	1" = 24 000	MARIPOSA
31	BEAR CREEK	1" = 400'	U S E D
32	LOWER BOOTJACK	1" = 24 000	MARIPOSA
33	W F CHOWCHILLA	1" = 100'	D W R
34	MORMON BAR	1" = 400'	D. W R
35	FAIRGROUNDS	1" = 24 000	MARIPOSA
36	STOCKTON CREEK AFTERBAY	1" = 24 000	MARIPOSA
37	STOCKTON CREEK	1" = 400'	M P U D
38	SUMMIT INN FOREBAY	1" = 24 000	FLICIANA MTN
39	BEAR CREEK AT SHANGHAI RIDGE	1" = 62 500	INDIAN GULCH
40	UPPER BEAR CREEK	1" = 400'	D W R
41	NORWEGIAN GULCH	1" = 400'	D W R
42	UPPER BEAR CREEK ALTERNATIVE	1" = 400'	D W R
43	BLACK RASCAL	7½ MINUTE	HAYSTACK MTN
44	CANAL CREEK	7½ MINUTE	YOSEMITE LAKE
45	BURNS CREEK	1" = 400'	U S E D.
46	LOWER BURNS CREEK	7½ MINUTE	HAYSTACK MTN
47	LOWER BURNS CREEK AFTERBAY	7½ MINUTE	HAYSTACK MTN
48	SNOW CREEK AFTERBAY	7½ MINUTE	STUMPFIELD MTN
49	SIERRA NATIONAL FOREST	1" = 400'	D W R
50	HORNITOS FOREBAY	7½ MINUTE	HORNITOS
51	NELSON COVE	1" = 400'	D W R
52	WILDCAT FOREBAY	1" = 400'	D W R
53	NELSON COVE MIDDLE SITE	1" = 400'	D W R
54	AGUA FRIA CREEK BELOW BUCKEYE	1" = 400'	D. W R
55	BUCKEYE CREEK	1" = 400'	D W R
56	OWL CREEK	1" = 400'	D. W R





LEGEND

STRATIGRAPHY

Qal ALLUVIUM

Alluvium consists of unsorted, unconsolidated stream and colluvial deposits.

Ti IONE FORMATION

The Ione formation consists predominantly of quartz sandstone with minor clays and conglomerates. These are moderately to well consolidated.

Jm MARIPOSA FORMATION - UNDIFFERENTIATED

The Mariposa formation is predominantly a black slate unit with some sandstone and conglomerate members. Strong slaty cleavage is characteristic of this unit. Although hard, the slates are incompetent and subject to slumping near the surface on steep slopes.

Jbc BRUSHY CANYON MEMBER

The Brushy Canyon member consists of sandstone and conglomerates which were locally differentiated from the Mariposa formation.

mv METAVOLCANIC ROCK

The metavolcanic rock coexists of flows, volcanic breccias, agglomerates, and tuffs of pyroxene andesite, which are commonly referred to as "greenstone." This unit includes metavolcanic rock members of the Calaveras and Amador formations. Rock members are massive, hard and competent.

Jaf AGUA FRIA FORMATION

The Agua Fria formation consists of conglomerates, agglomerates, tuffs, and some sandstone. This unit is only locally differentiated and may be a member of the Amador formation or Mariposa formation.

Cc CALAVERAS GROUP

The Calaveras group consists of hornfels, schists, phyllites, cherts, quartzite, and slates. As a unit these are very hard, veined, and lineated.

Ccq QUARTZITE

This unit consists of quartzite members of substantial thickness that were differentiated from the Calaveras group. The quartzites are hard, massive and brittle.

SYMBOLS

- Bedding Attitude
- Contact
- Inferred Contact
- Fault
- Anticline
- Syncline
- Injection Breccia Zone - Guadalupe Complex. Generally massive, hard, and competent.

BORROW AREAS

- Impervious
- Impervious (Questionable volume)
- Pervious - Rockfill quarry site
- Pervious - Stream gravels

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THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

MARIPOSA AREA INVESTIGATION

REGIONAL GEOLOGIC MAP
AND
LOCATION OF CONSTRUCTION MATERIALS

1965

SCALE OF MILES

1 0 1 2 3

LEGEND

INTRUSIVES

Id DIKES AND SILLS

grd GRANITIC ROCK

The granitic rock, forming the Sierra Nevada batholith, is a light colored, medium-grained crystalline igneous rock ranging in chemical composition from diorite to granite. It is very hard, massive, and moderately fractured. Spheroidal weathering and exfoliation is common in this unit. In the topographically flat areas, extensive decomposed granite mantle has developed on the granitic rock by deep, in-place weathering process.

Jgc GUADALUPE COMPLEX

The Guadalupe Complex consists of a complex intrusive unit of undifferentiated granodiorite, diorite, and gabbro-granodiorite injection breccia. These crystalline igneous rock members are finer grained than the granitic rock of the Sierra Nevada batholith. Rock members are hard and massive. The granodiorite member in the Cathey area exhibits local zones of deep weathering.

sp SERPENTINE

The Serpentine, an alteration of ultrabasic dike and sills, is incompetent, often sheared, and contorted. Slickensides are often developed in this unit.

REFERENCES

1. Bowen, O. E., Current geological mapping in the Mariposa Area, Div. of Mines, 1950.
2. Taliaferro, N. L., Recent geological mapping in the Indian Gulch Quadrangle, Univ. of California, 1957.
3. Turner, H. W. and Ransome, F. L., Sonora Folio, California, Folio 41, Geologic Atlas of U. S., U.S.G.S., 1897.

KEY TO QUADRANGLES

AREA LOCATION

NOTES

1. Base maps: 15 minute U.S.G.S. quadrangle sheets of -
   a) Coulterville Quad., C.I.= 10', 1947
   b) El Portal Quad., C.I.= 100, 1947
   c) Yosemite Valley Quad., Planimetric, 1927
   d) Indian Gulch Quad., C.I.=25, 1954
   e) Mariposa Quad., C.I.= 10', 1947
   f) Bass Lake Quad., C.I.= 80, 1953

LEGEND

STRATIGRAPHY

Qal ALLUVIUM

Alluvium consists of unsorted, unconsolidated stream and colluvial deposits

Ti IONE FORMATION

The Ione formation consists predominantly of quartz sandstone with minor clays and conglomerates. These are moderately to well consolidated.

Jm MARIPOSA FORMATION - UNDIFFERENTIATED

The Mariposa formation is predominantly a black slate unit with some sandstone and conglomerate members. Strong slaty cleavage is characteristic of this unit. Although hard, the slates are incompetent and subject to slumping near the surface on steep slopes.

Jbc BRUSHY CANYON MEMBER

The Brushy Canyon member consists of sandstone and conglomerates which were locally differentiated from the Mariposa formation.

mv METAVOLCANIC ROCK

The metavolcanic rock consists of flows, volcanic breccias, agglomerates, and tuffs of pyroxene andesite, which are commonly referred to as 'greenstone.' This unit includes metavolcanic rock members of the Calaveras and Amador formations. Rock members are massive, hard and competent.

Jaf AGUA FRIA FORMATION

The Agua Fria formation consists of conglomerates, agglomerates, tuffs, and some sandstone. This unit is only locally differentiated and may be a member of the Amador formation or Mariposa formation.

Cc CALAVERAS GROUP

The Calaveras group consists of bermfels, schists, argillite, lherte quartzite, and slates. As a unit these are very hard, veined, and lineated.

Ccq QUARTZITE

This unit consists of quartzite members of substantial thickness that were differentiated from the Calaveras group. The quartzites are hard, massive and brittle.

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